Big Qualicum River Project 1974 - 1975

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OCTOBER 1979

Fisheries and Marine Service Manuscript Report #1528

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Fisheries and Marine Service

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by

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ABSTRACT

This report contains relevant data on salmonid enhancement studies conducted on the Big Qualicum River during the period August 1, 1974 to July 31, 1975.

The Big Qualicum River is located on Vancouver Island, north of Parksville. The flow of the river is manipulated in response to local precipitation, the maintenance of the source (Horne Lake) as a recreational area and the requirements of the various fish-production facilities.

Similar sets of data have been collected for each of the four major species encountered in the system: chum salmon (Oncorhynchus keta), chinook salmon (O. tshawytscha), coho salmon (O. kisutch) and steelhead trout (Salmo gairdneri). Daily enumerations were made of the upstream migrations of adults and jacks as well as the downstream migrations of juveniles (fry and smolts). Fish were sampled for length and weight, fin-mark incidence, sex-ratios, and age composition. Egg deposition estimates and survival-rates have been included.

The age composition and origin of Big Qualicum chum salmon were determined for the escapement population as well as for those fish subjected to the commercial fishery. A final estimate of the survival of the 1969 brood indicated an overall rate of 0.69%.

In summary, upstream enumerations indicated the following returns: 96,396 chum adults; 554 chinook adults and 211 jacks; 15,511 coho adults and 2,827 jacks. An incomplete enumeration of steelhead indicated 39 adults. Typical sex-ratios were 45.2% females and 54.8% males in the chum escapement; 21.7% and 78.3% respectively for chinook; and 61.4% and 38.6% respectively for coho. The estimated egg deposition for chum salmon in both the spawning

channel and the river was 139.5 million. A total of 0.2 million chinook eggs and 13.3 million coho eggs were deposited in the river. Enumeration of the downstream migrants indicated a production of 65.0 million chum fry; 12,675 chinook fry and 6,897 chinook smolts (incomplete enumeration); 1.7 million coho fry and 9,374 coho smolts (incomplete enumeration); as well as 5,175 steelhead fry and 9,525 steelhead smolts. In addition, hatchery-reared fish were released as follows: 230,571 chinook smolts; 42,115 coho fry, 377,765 coho smolts; and 32,846 steelhead smolts.

KEY WORDS: chum salmon, chinook salmon, coho salmon, steelhead trout, escapement, production.

RÉSUMÉ

Le rapport présente des données recueillies au cours d'études concernant la mise en valeur des salmonidés, menées sur la rivière Big Qualicum entre le 1er août 1974 et le 31 juillet 1975.

La rivière Big Qualicum se trouve dans l'île Vancouver, au nord de Parksville. Le débit de la rivière est modifié artificiellement en fonction des préceipitations locales, de l'état de sa source (lac Horne), qui constitue une zone de loisirs, et des besoins de diverses installations de piscifacture.

Des séries semblables de données ont été recueillies pour chacune des quatre espèces principales qui se trouvent dans le cours d'eau: saumon kéta (Oncorhynchus keta), saumon quinnat (O. tshawytscha), saumon coho (O. kisutch) et truite arc-en-ciel anadrome (Salmo gairdneri). On a pratique des dénombrements quotidiens des adultes et des jeunes mâles en remonte, et des jeunes

(alevins et tacons) au cours de leur descente. On a étudié la longueur et le poids des échantillons, la présence de marques sur les nageoires, le rapport des sexes et la composition par âge. Des estimations sur la ponte et les taux de survie sont aussi présentés.

On a déterminé la composition par âge et l'origine des saumons kéta de la Big Qualicum à partir de la population de remonte ainsi que des prises de la pêche commerciale. L'estimation définitive de la survie de la génération de 1969 s'établit à un taux général de 0,69%.

Pour résumer, les dénombrements de la remonte ont donné les résultats suivants: 96 396 saumons kéta adultes; 554 quinnats adultes et 211 jeunes mâles; 15 511 saumons coho adultes et 2827 jeunes mâles. Le dénombrement incomplet de la truite arc-en-ciel anadrome a donné un résultat de 39 adultes. Le rapport des sexes caractéristique est de 45,2% de femelles et de 54,8% de mâles parmi les saumons kéta de remonte; 21,7 et 78.3% pour le saumon quinnat, et 61.4 et 38,6% pour le saumon coho. Le nombre d'oeufs déposés par les saumons kéta dans la frayère et dans la rivière est estimé à 139,5 millions. Un total de 0,2 million d'oeufs de saumon quinnat et de 13,3 millions d'oeufs de saumon coho a été pondu dans la rivière. Le dénombrement des jeunes en migration vers la mer a indiqué une production de 65 millions d'alevins de saumon kéta; 12 675 alevins et 6897 tacons de saumon quinnat (dénombrement incomplet); 1,7 million d'alevins et 9374 tacons de saumon coho (dénombrement incomplet), ainsi que 5175 alevins et 9525 tacons de truite arc-en-ciel anadrome. En outre, on note la mise en liberté de poissons élevés artificiellement: 230 571 tacons de saumon quinnat; 42 115 alevins et 377 765 tacons de saumon coho, et 32 846 tacons de truite arc-en-ciel anadrome.

Mots clés: saumon kéta, saumon quinnat, saumon coho, truite arc-en-ciel anadrome, remonte, production.

PREFACE

This report represents the third in a continuing series of similar studies and is intended for use by Fisheries Managers who may wish to manipulate the data to their particular need. Previous publications include: Big Qualicum River Project 1973 - 1974, Technical Report Series No. PAC/T-75-16; and Big Qualicum River Project 1972 - 1973, Technical Report Series No. PAC/T-75-15.

ACKNOWLEDGEMENTS

The authors would like to extend their thanks to the following people whose help in preparing this report was most appreciated:
D. C. Sinclair, R. A. L. Harvey, G. R. Ladouceur and D. R. Harding.

INTRODUCTION

BACKGROUND

The Big Qualicum River Salmon Development Project began in 1963 with the implementation of flow control and the construction of an eyeing station and a spawning channel for chum salmon (Oncorhynchus keta) (Fig. 1). Because of physical deficiencies, the channel was modified for use as an experimental rearing facility. At present, this channel, henceforth referred to as the rearing channel, is used for the production of chinook salmon (O. tshawytscha), coho salmon (O. kisutch), and steelhead trout (Salmo gairdneri).

A second spawning channel, designed specifically for chum salmon, has been in operation since 1967 (Fig. 2). In 1968 a hatchery with three 15.2 m Burrows' type ponds was constructed for the production of chinook and coho (Fig. 3).

This report includes a record of selected physical parameters of the Big Qualicum River system, and details the results of activities carried out to enhance the production of salmonids during the period August 1, 1974 to July 31, 1975.

PHYSICAL MONITORING

The Big Qualicum River flows from Horne Lake on Vancouver Island's east side for approximately 11.2 km before entering the Strait of Georgia. Its rate of flow is regulated by two hollow cone valves located at the end of a 518 m long tunnel which leads from Horne Lake and empties into the natural river bed (Fig. 1).

Two major monitoring activities are related to the valve regulation. First, the level of Horne Lake is recorded either at a staff gauge located on the tunnel intake works, or from an alternate location adjacent to the intake (Table 1).

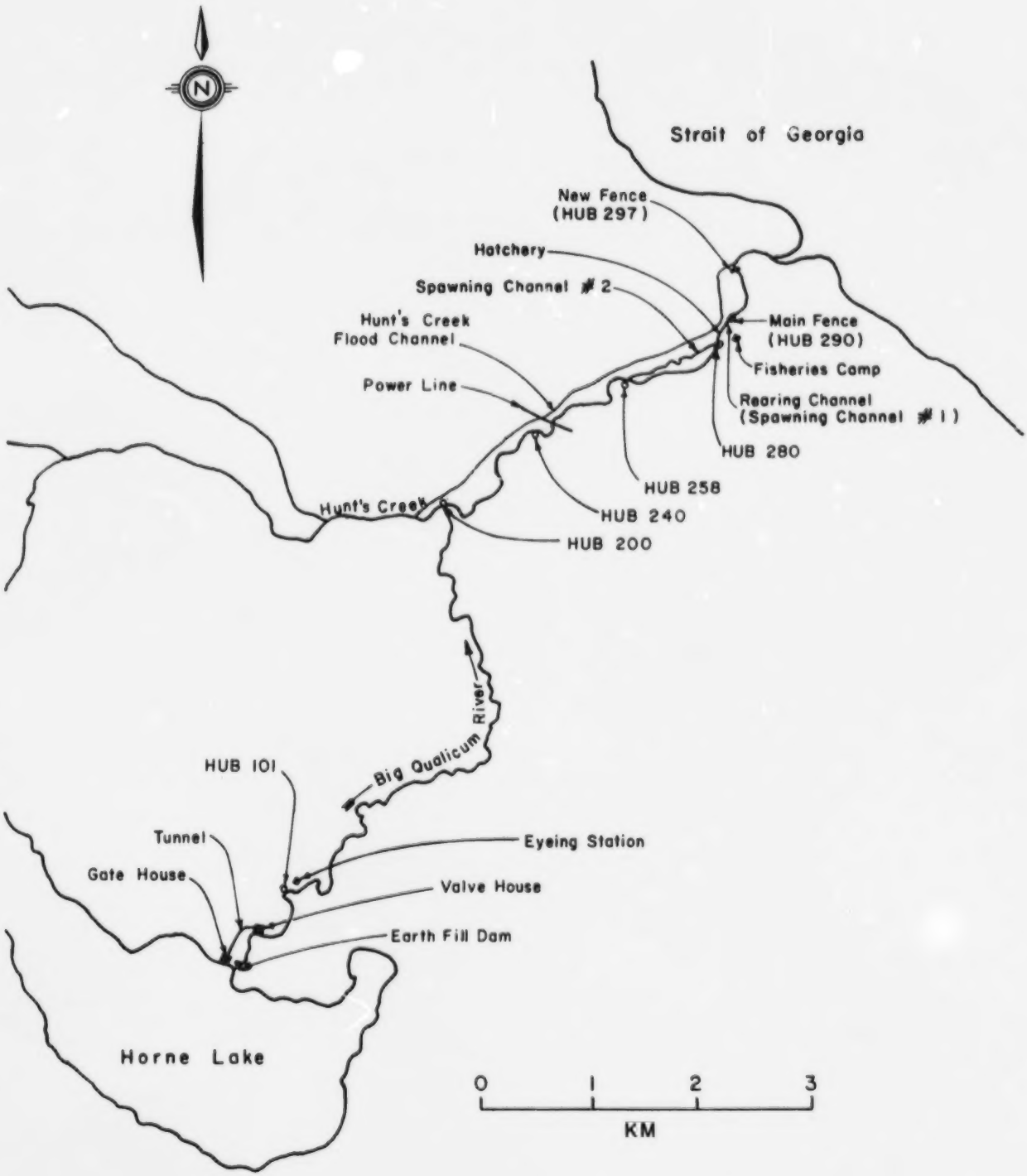

Fig. 1. Big Qualicum River.

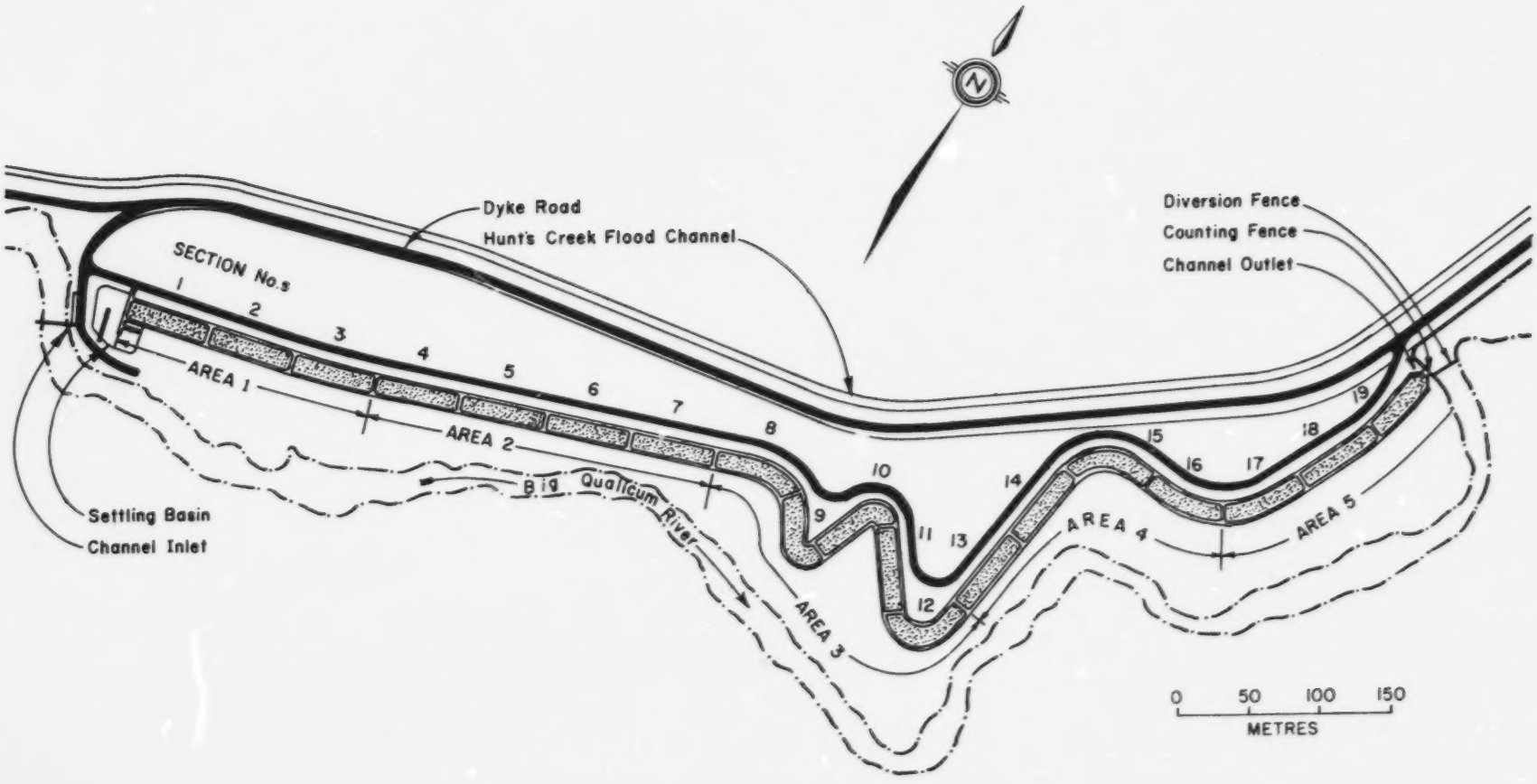

Fig. 2. Big Qualicum River spawning channel.

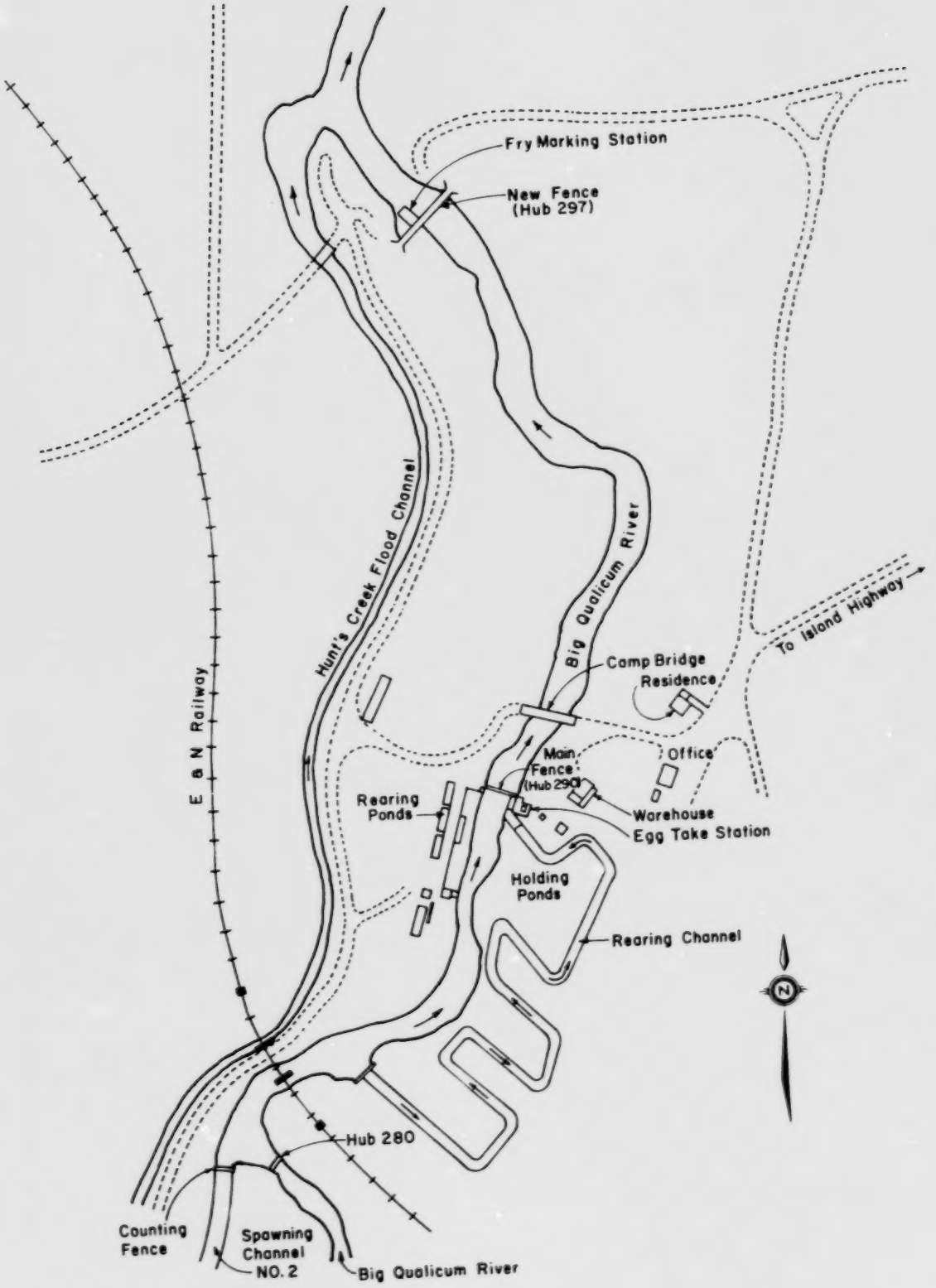

Fig. 3. Big Qualicum River project site.

Table 1. Horne Lake level, Big Qualicum River flow, and weekly precipitation from August 2, 1974 to July 30, 1975.

Date		Elevation (Metres above sea level)	Flow (Cubic metres per second)	Precipitation (mm)
Aug.	2	119.44	2.83	nil
(1974)	5	119.34	2.83	
	7	119.29	2.83	
	9	119.24	2.83	nil
	12	119.17	2.83	
	14	119.11	2.83	
	16	119.05	3.54	
	19	118.95	3.54	
	21	118.88	3.54	
	23	118.81	3.54	x[a]
	26	118.71	3.54	
	28	118.64	3.54	
	30	118.57	3.54	
Sept.	2	118.45	3.54	
	4	118.41	4.25	
	6	118.32	4.25	
	9	118.20	5.81	
	11	118.12	5.81	
	13	117.99	5.81	23
	16	117.80	14.16	
	18	117.41	24.07	
	20	116.95	19.82	
	23	116.30	18.97	
	25	115.89	19.54	
	27	115.45	5.66	
	30	115.27	5.66	
Oct.	2	115.19	5.66	
	4	115.09	5.66	38
	7	114.90	5.66	
	9	114.78	5.66	
	11	114.70	5.66	5
	14	114.49	5.66	
	16	114.37	5.66	
	18	114.25	5.66	
	21	114.08	5.66	
	23	113.96	5.66	
	25	113.82	5.55	10
	28	113.66	5.66	
	30	113.56	5.66	

(Continued)

Table 1. Horne Lake level, Big Qualicum River flow, and weekly precipitation from August 2, 1974 to July 30, 1975. (Continued)

Date		Elevation (Metres above sea level)	Flow (Cubic metres per second)	Precipitation (mm)
Nov.	1	113.44	4.25	
	4	113.28	4.25	
	6	113.30	4.25	
	8	113.29	4.25	82
	11	113.41	4.25	
	13	113.76	4.25	
	15	113.80	4.25	99
	18	113.89	4.25	
	20	114.01	4.96	
	22	114.09	4.96	13
	25	115.31	5.44	
	27	115.54	5.81	
	29	115.57	5.81	51
Dec.	2	115.54	5.95	
	4	115.66	5.95	
	6	121.88	5.95	23
	9	115.88	5.95	
	11	116.15	6.09	
	13	116.30	7.65	47
	16	116.34	7.65	
	17	116.95	7.79	
	20	117.14	8.50	115
	23	117.43	8.50	
	24	117.41	8.50	
	27	117.40	8.50	41
	30	117.40	8.50	
	31	117.40	8.50	
Jan. (1975)	3	117.38	8.50	77
	6	117.34	8.50	
	8	117.28	8.50	
	10	117.16	8.50	51
	13	117.02	8.50	
	15	116.90	8.50	
	17	116.80	8.44	49
	20	116.82	8.50	
	22	116.79	8.50	
	24	116.88	8.50	22
	27	116.85	8.50	
	29	116.77	8.50	
	31	116.64	8.50	5

(Continued)

Table 1. Horne lake level, Big Qualicum River flow, and weekly precipitation from August 2, 1974 to July 30, 1975. (Continued)

Date	Elevation (Metres above sea level)	Flow (Cubic metres per second)	Precipitation (mm)
Feb. 3	116.49	8.41	
5	116.37	8.35	
7	113.18	8.35	50
10	116.00	7.08	
13	115.92	7.08	89
21	115.57	4.25	6
24	115.76	4.25	
26	115.88	4.25	
28	116.00	4.25	66
Mar. 3	116.55	4.25	
5	116.73	4.25	
7	116.77	4.11	8
10	116.77	4.25	
12	116.77	4.25	
14	116.76	4.25	29
17	116.88	4.25	
19	117.03	4.16	
21	117.12	4.16	43
24	117.16	4.16	
26	117.15	4.16	
28	117.10	4.16	2
Apr. 1	117.10	3.96	
2	117.10	3.96	
4	117.12	3.96	21
7	117.10	3.96	
9	117.07	3.96	
11	117.07	3.96	
14	117.15	3.96	
16	117.18	3.96	
18	117.21	3.96	4
21	117.26	3.96	
23	117.27	3.96	
25	117.27	3.96	2
28	117.28	3.96	
30	117.28	3.96	19
May 5	117.37	3.96	
7	117.38	3.74	
9	117.40	3.82	4
12	117.53	3.82	
14	117.55	3.82	
16	117.59	3.82	6

(Continued)

Table 1. Horne Lake level, Big Qualicum River flow, and weekly precipitation from August 2, 1974 to July 30, 1975. (Concluded)

Date	Elevation (Metres above sea level)	Flow (Cubic metres per second)	Precipitation (mm)
May 21	117.63	3.82	
23	117.63	3.82	16
26	117.59	3.82	
28	117.57	3.82	
30	117.57	3.82	
June 2	117.59	3.82	
4	117.60	1.42	
6	117.65	1.47	1
9	117.69	1.47	
11	117.71	1.47	
13	117.74	1.47	1
16	117.77	1.42	
18	117.77	1.42	
20	117.78	1.47	
23	117.79	1.42	
25	117.79	1.42	
27	117.80	1.42	
July 1	117.79	1.36	
2	117.79	1.42	
4	117.79	1.42	
7	117.77	1.36	
9	117.77	1.36	
11	117.76	1.36	2
14	117.71	1.36	
16	117.71	1.36	
18	117.67	1.36	4
21	117.63	1.36	
23	117.60	1.36	
25	117.59	1.36	1
28	117.55	1.36	
30	117.52	1.36	2

[a] x indicates trace amount of precipitation.

Second, a measurement of flow is made at a gauging weir located downstream from the valve site.

Fluctuations in lake levels are a result of controlled river flow and local precipitation. Factors considered in determining and therefore regulating the flow of the Big Qualicum River include the water requirements of the fish production facilities, the maintenance of Horne Lake as a recreational area, and the seasonal change in precipitation. River water temperatures were also recorded (Table 2).

ENUMERATION AND SAMPLING

Since 1959, enumeration and sampling programs have been conducted on upstream and downstream migrations to assess the various operations of the project.

Upstream migrations

In the fall of 1974, all upstream migrants were counted at the main fence (Fig. 1). The fence consisted of a weir which spanned the full width of the river. Panels were raised to allow fish to pass through the fence and over sheets of white flashing laid on the river bottom. When the fence was open, a continuous count was recorded by an observer stationed in a tower on the bank.

A live-trap through which some or all of the migrants could be diverted, was also operated. Fish required for egg-take or sampling purposes were transferred from the trap to adjacent holding ponds. Chinook and coho adult fish were usually trapped and counted. Chum adults however, were simply enumerated as they swam past the fence.

Sampled adults were measured (post-orbital to hypural length), aged (scale readings) and sexed. In addition, some coho were weighed.

The noses of adipose-marked fish that had been used for egg-take or had died in holding ponds, were removed and examined for the presence of a

Table 2. Mean water temperatures taken at the camp bridge on the Big Qualicum River from August 1, 1974 to July 31, 1975.

Date span	Mean water temperature (^{o}C)
Aug. 1 - 10	13.1
Aug. 11 - 20	12.7
Aug. 21 - 30	12.8
Aug. 31 - Sept. 9	12.9
Sept. 10 - 19	14.6
Sept. 20 - 29	14.6
Sept. 30 - Oct. 9	12.4
Oct. 10 - 19	12.2
Oct. 20 - 29	11.4
Oct. 30 - Nov. 8	10.6
Nov. 9 - 18	9.5
Nov. 19 - 28	7.5
Nov. 29 - Dec. 8	7.6
Dec. 9 - 18	6.8
Dec. 19 - 28	5.9
Dec. 29 - Jan. 7, 1975	4.7
Jan. 8 - 17	3.7
Jan. 18 - 27	3.8
Jan. 28 - Feb. 6	3.1
Feb. 7 - 16	2.5
Feb. 17 - 26	2.9
Feb. 27 - March 8	3.3
March 9 - 18	4.1
March 19 - 28	4.4
March 29 - April 7	5.3
April 8 - 17	6.9
April 18 - 27	7.6
April 28 - May 7	8.5
May 8 - 17	10.1
May 18 - 27	10.1
May 28 - June 6	11.7
June 7 - 16	13.7
June 17 - 26	13.7
June 27 - July 6	16.5
July 7 - 16	15.4
July 17 - 26	13.7
July 27 - 31	13.3

coded-wire tag. These tags, inserted when the fish were juveniles, provide coded information which assists in determining the effect of origin, diet, size and time of release on survival. During 1974-75, daily records of adult returns were kept for each of the four major species.

Downstream migrations

In the spring of 1975, fry and smolts migrating downstream were counted at the new fence (Fig. 1). This fence was divided into ten bays, each 3 m wide. For the trapping of juveniles, the two outside bays were completely blocked off making them 'fish-tight'. The remaining eight bays were stop-logged to a height of 90 cm. A 15 cm wide Wolf trap was hinged to the top stop-log in the centre of each bay. Each trap extended 3.66 m downstream and discharged into a 38 cm by 41 cm covered aluminum trough. The trough was suspended at right angles to the traps and continued along the entire length of the fence. It then emptied into a 76 cm by 41 cm by 1.8 m floating live-box. Fish were transferred from the live-box to the sampling laboratory for identification and enumeration prior to their release into the river.

Because only a portion of the migration was captured at the new fence, a catchability coefficient for chum fry was calculated. Marked fish were released above the fence and a record kept of the number recaptured. The appropriate catchability coefficient, i.e. number released to number recaptured, was multiplied by the daily catch at the fence. The result represents the daily migration. Catchability tests were not made for chinook or coho smolts in 1975. Therefore, 1974 catchability coefficients were used.

To obtain a count of the fry trapped daily, several 90 g samples were taken each time the live-box was emptied. From this, a number-to-weight factor was calculated for each species. This factor was then multiplied by the daily

weight to give the daily catch. The catchability coefficient for chum fry could then be applied to give the daily migration. Based on the assumption that all fry react similarly to the trapping gear, the chum catchability figure was used for fry of all species.

Daily records of the catch of migrating juveniles at the new fence were kept. Because the new fence does not trap all the fish, zero catch does not necessarily imply zero migration. Mean lengths and weights, as well as condition coefficients of juveniles have also been determined.

CHUM ADULTS

ENUMERATION AND DISTRIBUTION

The 1974 chum salmon run began October 2 and continued until December 24. During that time an actual count indicated that 80,969 adults passed through the main fence (Table 3). Of these, 21,109 were diverted into the spawning channel while the remaining 59,860 dispersed upstream of the fence. An estimated 15,427 fish spawned below the fence bringing the total escapement to 96,396 fish.

To establish which areas were utilized by the river spawners, distribution counts were made periodically during the migration (Table 4). These counts were conducted at the various survey hub-markers along the river (Fig. 1, Table 5).

The total count of spawners in each area above the main fence was used to determine the percentage distribution of fish in the river (Table 6). These percentages in turn, were applied to the main fence enumeration, i.e. 59,860 fish. The results provide a final estimate of the numbers of chum salmon spawning in each area of the river (Table 7).

Spawned-out or spent chum of both sexes were recovered from the main fence and checked for the presence of fin-marks (Table 8). Of 2,433 fish recovered, 1,209 (49.7%) were males and 1,224 (50.3%) were females. The marked fish comprised 2.8% of the total dead-sample. Of these, 42 were missing adipose and left ventral fins, 23 were without adipose and right ventral fins, and 4 were marked adipose only.

MAIN FENCE LIVE-SAMPLE

From November 6 until December 16, 1974, a sampling program was carried out on the adult chum salmon passing through the main fence. The purpose of

Table 3. Daily enumeration of the upstream migration of adult chum salmon at the main fence, 1974.

Date	Daily count	Cumulative migration	% cumulative migration
Oct. 2	3	3	
3	2	5	
7	2	7	
8	1	8	
9	2	10	
10	4	14	
11	5	19	
12	2	21	
13	3	24	
14	2	26	
15	4	30	
16	0	30	
17	1	31	
18	3	34	
19	6	40	
20	4	44	0.1
21	7	51	0.1
22	3	54	0.1
23	1	55	0.1
24	1	56	0.1
25	0	56	0.1
26	3	59	0.1
27	13	72	0.1
28	21	93	0.1
29	10	103	0.1
30	8	111	0.1
31	24	135	0.2
Nov. 1	31	166	0.2
2	17	183	0.2
3	16	199	0.2
4	959	1,158	1.4
5	1,071	2,229	2.8
6	1,406	3,635	4.5
7	841	4,476	5.5
8	879	5,355	6.6
9	1,605	6,960	8.6
10	1,172	8,132	10.0
11	2,868	11,000	13.6
12	6,350	17,350	21.4
13	582	17,932	22.1
14	567	18,499	22.8
15	957	19,456	24.0

(Continued)

Table 3. Daily enumeration of the upstream migration of adult chum salmon at the main fence, 1974. (Concluded)

Date	Daily count	Cumulative migration	% cumulative migration
Nov. 16	1,141	20,597	25.4
17	3,403	24,000	29.6
18	5,514	29,514	36.5
19	918	30,432	37.6
20	195	30,627	37.8
21	193	30,820	38.1
22	4,306	35,126	43.4
23	2,020	37,146	45.9
24	16,003	53,149	65.6
25	2,847	55,996	69.2
26	476	56,472	69.7
27	478	56,950	70.3
28	515	57,465	71.0
29	394	57,859	71.5
30	762	58,621	72.4
Dec. 1	728	59,349	73.3
2	2,345	61,694	76.2
3	2,261	63,955	79.0
4	1,309	65,264	80.6
5	1,126	66,390	82.0
6	2,003	68,393	84.5
7	919	69,312	85.6
8	1,865	71,177	87.9
9	2,733	73,910	91.3
10	1,493	75,403	93.1
11	404	75,807	93.6
12	951	76,758	94.8
13	723	77,481	95.7
14	441	77,922	96.2
15	385	78,307	96.7
16	1,702	80,009	98.8
17	427	80,436	99.3
18	209	80,645	99.6
19	128	80,773	99.8
20	103	80,876	99.9
21	62	80,938	
22	20	80,958	
23	4	80,962	
24	7	80,969	100.0

Table 4. Distribution counts of spawning chum salmon in the Big Qualicum River, 1974. (Does not include the spawning channel.)

Date	Main river section: Hub markers[a] above the main fence 101-199	200-257	258-281	282-290	Hub markers below the main fence 291-297	298-mouth
Oct. 28	-	-	-	-	315	80
31	-	-	-	-	510	100
Nov. 3	-	-	-	-	630	130
6	-	-	-	-	1,055	40
9	-	-	-	-	1,435	40
12	-	-	-	-	1,540	60
15	-	-	-	-	1,465	60
18	2,441	6,319	5,375	97	1,970	60
21	-	-	-	-	1,280	100
24	629	607	792	250	2,630	100
27	-	-	-	-	2,780	50
30	-	-	-	-	1,077	323
Dec. 3	-	-	-	-	2,900	250
6	-	-	-	-	2,560	300
9	646	715	4,927	387	2,325	200
12	-	-	-	-	2,395	150
15	991	501	3,265	109	1,530	150
18	-	-	-	-	925	110
21	-	-	-	-	620	90
24	-	-	-	-	640	50
27	-	-	-	-	340	60
Totals	4,707	8,142	14,359	843	30,922	2,503

[a] Surveyor's reference markers for distribution purposes.

Table 5. Estimated number and distribution of adult chum spawning below the main fence, 1974.

Location by hub marker	Total no. of fish counted[a]	Estimated no. of fish (Total x 3 / 6.5)[b]
291-297	30,922	14,272
297-Mouth	2,503	1,155
291-Mouth	33,425	15,427

[a] From Table 4.

[b] Total no. of fish counted x count frequency in days / average residency on spawning grounds in days.

Table 6. Distribution of adult chum spawning above the main fence, 1974 . (Excludes the spawning channel).

Location by hub marker	Total no. of fish counted	% adults above main fence
101-199	4,707	16.8
200-257	8,142	29.0
258-281	14,359	51.2
282-290	843	3.0
101-290	28,051	100.0

Table 7. Distribution summary of adult chum salmon spawning in the Big Qualicum River, 1974.

Area	Location	Number of spawners	% of total escapement
Main river (above main fence)	Hub 101-199	10,056	10.4
	Hub 200-257	17,359	18.0
	Hub 258-281	30,649	31.8
	Hub 282-290	1,796	1.9
	Hub 101-290	59,860	62.1
Main river (below main fence)	Hub 291-297	14,272	14.8
	Hub 297-Mouth	1,155	1.2
	Hub 291-Mouth	15,427	16.0
Spawning channel		21,109	21.9
Total river		96,396	100.0

Table 8. Sex and fin-mark incidence of spent adult chum salmon dead-pitched above the main fence, 1974.

Date	No. males		No. females		No. both sexes	Fin-mark recoveries[b]			
	Daily	Cumulative	Daily	Cumulative	Cumulative	AD/LV	AD/RV	AD/AN	AD
Nov. 2	1	1	1	1	2				
3	1	2	1	2	4				
4	5	7	2	4	11				
5	3	10	2	6	16				
11	7	17	1	7	24				
12	1	18	1	8	26	1			
14	6	24	4	12	36				
15	12	36	13	25	61	1			
16	13	49	4	29	78				
17	12	61	5	34	95				
23	21	82	15	49	131	1			
24	38	120	20	69	189	1			
25	41	161	26	95	256	1			
26[a]	--	161	100	195	356	1			
28	21	182	15	210	392	2	1		
30	54	236	48	258	494	1			
Dec. 1	33	269	36	294	563	1			
2	9	278	3	297	575				
4	41	319	28	325	644	2			
5	70	389	57	382	771	1	1		1
7	90	479	81	463	942	3	1		1
8	49	528	38	501	1,029	3	2		1
9	42	570	42	543	1,113	2	1		
10	152	722	155	698	1,420	3	4		1
11	75	797	101	799	1,596	2	3		
12	70	867	61	860	1,727	1	1		
14	108	975	133	993	1,968	5			
15	110	1,085	129	1,122	2,207	6	3		
16	124	1,209	102	1,224	2,433	4	6		
Total		1,209		1,224	2,433	42	23	0	4

[a] 100 females sampled from Hub 280.

[b] Fin-marks: AD - Adipose, LV - Left ventral, AN - anal, RV - Right ventral.

this program was to record the incidence of fin-marked fish and to establish a sex-ratio in the escapement population. Each day, a sample of fish was checked for fin-marks. All marked fish were then aged, sexed and measured. In addition, a weekly sample of marked and unmarked fish was similarly examined.

A total of 5,270 fish, representing 6.5% of the chum salmom that passed through the main fence were live-sampled. Of these, 2,888 (54.8%) were males and 2,382 (45.2%) were females. Examination for fin-marks indicated that 85 fish were missing adipose and left ventral fins, 54 were without adipose and right ventrals, 3 were without adipose-anals, and 10 were marked adipose-only. Marked fish accounted for 2.9% of the total live-sample (Table 9).

The sample size was not proportionate to the fluctuations in the total daily migrations. An adjustment factor was therefore calculated and applied to the daily fin-mark counts. This provided an estimate of marked fish in the total escapement (Table 10). The mean length of 273 sampled females was 603 mm while that of 312 males was 611 mm (Table 11).

SPAWNING CHANNEL DEAD-PITCH SAMPLE

On November 18, 1974, the weir at hub 280 was closed, halting continued access to the river. The fence located at the outlet of the spawning channel was then opened, and adult chum salmon were diverted (Fig. 3). A V-shaped gate was installed in the fence to inhibit fish from escaping back downstream after enumeration.

A second V-gate was placed in the fence located at the bottom of section 4 of the spawning channel (Fig. 2). When the desired number of fish had entered area 1, the V-gate was replaced by a standard fence panel to prevent further recruitment into the area. This procedure was repeated until each of the remaining four areas was filled with the desired number of fish. Upon completion, the V-gate which had been installed at the channel outlet

Table 9. Sex and fin-mark incidence of adult chum salmon live-sampled at the main fence, 1974.

Date	No. adults sampled			Fin-mark recoveries[a]			
	Males	Females	Both sexes	AD/LV	AD/RV	AD/AN	AD
Nov. 6	174	108	282	6	4		
7	98	48	146	5	2		
8	106	56	162	2	1		2
9	183	111	294	5	3		
10	101	68	169	7	5		
11	78	39	117	3			1
12	391	166	557	8	4		2
13	145	69	214	3	1		
14	48	42	90	3			
15	28	24	52	1			
16	59	63	122	1	2		
17	--	--	--				
18	132	75	207	3	1	1	1
19	25	15	40	2		1	
20	12	12	24		1		
21	25	21	46				
22	39	76	115	2	1		
23	84	92	176		4	1	
24	156	133	289	4	4		
25	60	40	100		3		
26	52	41	93	1			
27	57	59	116	2	2		1
28	47	67	114		3		
29	--	--	--				
30	20	24	44				
Dec. 1	24	38	62	1			
2	52	81	133	2	4		
3	75	186	261	1	2		1
4	89	146	235	10	2		1
5	66	66	132				
6	76	136	212	2			
7	40	33	73				
8	40	51	91	1	1		
9	82	79	161	4	2		1
10	33	21	54	2	1		
11	33	32	65	2			
12	27	13	40				
13	28	22	50	1			
14	6	2	8				
15	--	--	--				
16	97	27	124	1	1		
Total	2,888	2,382	5,270	85	54	3	10

[a] Fin-marks: AD - Adipose, LV - Left ventral, AN - Anal, RV - Right ventral.

Table 10. Estimated incidence of fin-marks in the total escapement of adult chum salmon above the main fence, 1974.

Date	No. adults sampled[a]	Daily escapement[b]	Adjustment factor[c]	Estimated fin-mark incidence[d]			
				AD/LV	AD/RV	AD/AN	AD
Nov. 6	282	1,406	4.99	30	20		
7	146	841	5.76	29	12		
8	162	879	5.43	11	5		11
9	294	1,605	5.46	27	16		
10	169	1,172	6.93	49	35		
11	117	2,868	24.51	74			25
12	557	6,350	11.40	91	46		23
13	214	582	2.72	8	3		
14	90	567	6.30	19			
15	52	957	18.40	18			
16	122	1,141	9.35	9	19		
17	--	3,403	--				
18	207	5,514	26.64	80	27	27	27
19	40	918	22.95	46		23	
20	24	195	8.13		8		
21	46	193	4.20				
22	115	4,306	37.44	75	37		
23	176	2,020	11.48		46	11	
24	289	16,003	55.37	221	221		
25	100	2,847	28.47		85		
26	93	476	5.12	5			
27	116	478	4.12	8	8		4
28	114	515	4.52		14		
29	--	394	--				
30	44	762	17.32				

(Continued)

Table 10. Estimated incidence of fin-marks in the total escapement of adult chum salmon above the main fence, 1974. (Concluded)

Date	No. adults sampled[a]	Daily escapement[b]	Adjustment factor[c]	Estimated fin-mark incidence[d]			
				AD/LV	AD/RV	AD/AN	AD
Dec. 1	62	728	11.74	12			
2	133	2,345	17.63	35	71		
3	261	2,261	8.66	9	17		9
4	235	1,309	5.57	56	11		6
5	132	1,126	8.57				
6	212	2,003	9.45	19			
7	73	919	12.59				
8	91	1,865	20.49	20	20		
9	161	2,733	16.98	68	34		17
10	54	1,493	27.65	55	28		
11	65	404	6.22				
12	40	951	23.78				
13	50	723	14.46	14			
14	8	441	55.13				
15	--	385	--				
16	124	1,702	13.73	14	14		
Total	5,270	77,780	13.97	1,102	797	61	122

[a] From Table 9.

[b] From Table 3.

[c] Adjustment factor = escapement on sampling days / no. of adults sampled.

[d] Estimated fin-mark incidence = adjustment factor x fin-mark recoveries from Table 9.

Table 11. Age, sex and length statistics of marked and unmarked adult chum salmon live-sampled at the main fence, 1974.

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Unmarked	Males	3	61	14.56		570.33	28.92
		4	54	12.89		615.46	23.56
		5	113	26.97		628.58	28.45
		6	4	0.95		643.75	27.80
		Unknown	10		2.05	588.00	36.30
		All	242		49.69	609.55	37.03
	Females	3	39	9.31		557.82	25.20
		4	63	15.04		602.78	29.64
		5	83	19.81		618.01	25.48
		6	2	0.48		587.50	31.82
		Unknown	8		1.64	615.63	33.22
		All	195		40.04	600.64	35.14
	Not sexed	3	9		1.85	569.44	26.04
		4	10		2.05	616.50	16.34
		5	30		6.16	626.83	22.57
		6	1		0.21	615.00	0
		Unknown	0				
		All	50		10.27	614.20	30.46
	All fish	3	109		22.38	565.78	27.82
		4	127		26.08	609.25	26.96
		5	226		46.41	624.47	27.01
		6	7		1.44	623.57	35.68
		Unknown	18		3.70	600.28	36.76
		All	487		100.00	606.46	35.93

(Continued)

Table 11. Age, sex and length statistics of marked and unmarked adult chum salmon live-sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose only	Males	3	1	10.00		550.00	0
		4	0				
		5	2	20.00		622.50	17.68
		6	0				
		Unknown	0				
		All	3		30.00	598.33	43.69
	Females	4	2	20.00		605.00	35.36
		5	5	50.00		618.00	26.37
		6	0				
		Unknown	0				
		All	7		70.00	614.28	26.68
	All fish	3	1		10.00	550.00	0
		4	2		20.00	605.00	35.36
		5	7		70.00	619.29	22.82
		6	0				
		Unknown	0				
		All	10		100.00	609.50	30.95
Adipose Right Ventral	Males	3	4	7.69		585.00	28.58
		4	8	15.38		615.00	17.11
		5	16	30.77		622.25	23.35
		6	0				
		Unknown	2		3.70	612.50	10.61
		All	30		55.56	614.70	24.88

(Continued)

Table 11. Age, sex and length statistics of marked and unmarked adult chum salmon live-sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose Right Ventral	Females	3	4	7.69		567.50	30.14
		4	8	15.38		598.13	24.34
		5	12	23.08		623.15	12.27
		6	0				
		Unknown	0				
		All	24		44.44	605.83	28.54
	All fish	3	8		14.81	576.25	28.76
		4	16		29.63	606.56	22.11
		5	28		51.85	622.89	19.10
		6	0				
		Unknown	2		3.70	612.50	10.61
		All	54		100.00	610.76	26.43
Adipose Left Ventral	Males	3	0				
		4	18	23.38		611.67	24.85
		5	15	19.48		627.00	25.83
		6	1	1.30		665.00	0
		Unknown	1		1.20	605.00	0
		All	35		42.17	619.57	26.61
	Females	3	0				
		4	27	35.06		603.33	20.66
		5	16	20.78		622.50	26.89
		6	0				
		Unknown	3		3.61	606.67	20.21
		All	46		55.42	610.22	24.27

(Continued)

Table 11. Age, sex and length statistics of marked and unmarked adult chum salmon live-sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose	Not	3	0				
Left	sexed	4	1			620.00	0
Ventral		5	1			620.00	0
		6	0				
		Unknown	0				
		All	2		2.41	620.00	0
	All fish	3	0				
		4	46		55.42	606.96	22.37
		5	32		38.55	624.53	25.63
		6	1		1.20	665.00	0
		Unknown	4		4.82	606.25	16.52
		All	83		100.00	614.40	25.27
Adipose	Males	3	0				
Anal		4	0				
		5	2	66.67		637.50	60.10
		6	0				
		Unknown	0				
		All	2		66.67	637.50	60.10
	Females	3	0				
		4	0				
		5	1	33.33		620.00	0
		6	0				
		Unknown	0				
		All	1		33.33	620.00	0

(Continued)

Table 11. Age, sex and length statistics of marked and unmarked adult chum salmon live-sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose	All fish	3	0				
Anal		4	0				
		5	3		100.00	631.67	43.69
		6	0				
		Unknown	0				
		All	3		100.00	631.67	43.69
Marked	Males	3	66	11.76		570.91	28.80
and		4	80	14.26		615.00	28.29
unmarked		5	148	26.38		627.78	27.71
		6	5	0.89		648.00	25.88
		Unknown	13		2.04	593.08	33.08
		All	312		48.98	611.36	35.17
	Females	3	43	7.66		558.72	25.45
		4	100	17.83		602.60	26.81
		5	117	20.86		619.15	24.32
		6	2	0.36		587.50	31.82
		Unknown	11		1.73	613.18	29.52
		All	273		42.86	603.16	32.82

(Continued)

Table 11. Age, sex and length statistics of marked and unmarked adult chum salmon live-sampled at the main fence, 1974. (Concluded)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Marked and unmarked	Not sexed	3	9		1.41	569.44	26.04
		4	11		1.73	616.82	15.54
		5	31		4.87	626.61	22.23
		6	1		0.16	615.00	0
		Unknown	0				
		All	52		8.16	614.42	29.88
	All fish	3	118		18.52	566.36	27.81
		4	191		29.98	608.65	25.55
		5	296		46.48	624.23	26.12
		6	8		1.26	628.75	36.13
		Unknown	24		3.77	602.29	32.47
		All	637		100.01	608.09	34.00

[a]Number sampled as a percent of the total number of fish sampled with a given fin-mark.

was replaced by a fence panel, thereby closing off access to the channel. The entire exercise was completed November 25, 1974, at which time the weir at hub 280 was reopened giving late migrants access to the upper river.

From November 23 to December 31, spent fish were removed daily from the channel. The fish were sexed, and the incidence of fin-marks recorded (Table 12). A total of 21,109 chum salmon spawned in the channel in 1974. Of these, 11,176 (52.9%) were males and 9,933 (47.1%) were females. Marked fish comprised 2.4% of the dead-sample. In total, 212 fish were missing adipose and left ventral fins, 225 were without adipose and right ventrals, 21 were without adipose-anals, and 44 were marked adipose-only. In total, 350 fish were sampled for age, sex and length (Table 13). The mean length of 175 males was 609 mm , while that of 175 females was 594 mm.

EGG RETENTION, FECUNDITY AND EGG DEPOSITION

In order to calculate egg deposition in the river, it was necessary first to determine the proportion of eggs retained by the females after they had spawned. Egg retention in the 175 females sampled in the spawning channel was found to be 13.2%. A sample of 100 spent females taken from above the main fence was examined to provide a percentage retention for the river spawners. Each fish was assigned a code which indicated the approximate number of eggs retained. For example, code 1 represented a retention of roughly 125 eggs; code 2, 375 eggs and code 3, 1,250 eggs. The mean length of the sampled fish was 604 mm with a standard deviation of 28 mm. From the data collected, the percent egg retention in the sampled fish was calculated as follows:

1) Egg retention:

Code	Average Number Eggs Retained	Number of Fish Sampled
1	125	94
2	375	5
3	1,250	1

Table 12. Sex and fin-mark incidence of spent adult chum salmon dead-pitched from the spawning channel, 1974.

Date	No. males		No. females		No. both sexes	Fin-mark recoveries[a]			
	Daily	Cumulative	Daily	Cumulative	Cumulative	AD/LV	AD/RV	AD/AN	AD
Nov. 23	1	1	1	1	2		1		
24	65	66	86	87	153	1	3	1	
25	676	742	448	535	1,277	17	17	4	4
26	486	1,228	354	889	2,117	7	4	1	3
27	297	1,525	308	1,197	2,722	6	3	1	4
28	294	1,819	454	1,651	3,470	11	9	1	
29	444	2,263	746	2,397	4,660	4	22		3
30	902	3,165	1,166	3,563	6,728	18	24		4
Dec. 1	1,690	4,855	1,898	5,461	10,316	38	39	6	7
2	2,474	7,329	2,299	7,760	15,089	51	46	2	6
3	1,761	9,090	1,254	9,014	18,104	30	37	1	8
4	953	10,043	337	9,351	19,394	14	10	2	
5	473	10,516	181	9,532	20,048	5	2	2	1
6	228	10,744	45	9,577	20,321	4	1		
7	96	10,840	13	9,590	20,430	1			1
8	42	10,882	17	9,607	20,489		1		
9	20	10,902	17	9,624	20,526				
10	2	10,904	7	9,631	20,535	1			
11	12	10,916	10	9,641	20,557	1			
12	87	11,003	87	9,728	20,731		4		1
13	--	11,003	--	9,728	20,731				
14	29	11,032	49	9,777	20,809	1	1		1
15	27	11,059	25	9,802	20,861		1		1
16	34	11,093	29	9,831	20,924				
17	11	11,104	4	9,835	20,939				
18	54	11,158	94	9,929	21,087	2			
19	8	11,166	1	9,930	21,096				
20	--	11,166	--	9,930	21,096				

(Continued)

Table 12. Sex and fin-mark incidence of spent adult chum salmon dead-pitched from the spawning channel, 1974. (Concluded)

Date	No. males		No. females		No. both sexes	Fin-mark recoveries[a]			
	Daily	Cumulative	Daily	Cumulative	Cumulative	AD/LV	AD/RV	AD/AN	AD
Dec. 21	-	11,166	-	9,930	21,096				
22	2	11,168	0	9,931	21,098				
23	2	11,170	1	9,931	21,101				
24	-	11,170	-	9,931	21,101				
25	-	11,170	-	9,931	21,101				
26	-	11,170	-	9,931	21,101				
27	2	11,172	1	9,932	21,104				
28	-	11,172	-	9,932	21,104				
29	2	11,174	1	9,933	21,107				
30	1	11,175	0	9,933	21,108				
31	1	11,176	0	9,933	21,109				
Total		11,176		9,933	21,109	212	225	21	44

[a]Fin-marks: AD - Adipose, LV - Left ventral, AN - Anal, RV - Right ventral.

Table 13. Age, sex and length statistics of marked and unmarked adult chum salmon dead-pitched from the spawning channel, 1974.

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Unmarked	Males	3	36	10.9		574	34
		4	59	17.8		608	32
		5	73	22.1		629	30
		Unknown	4		1.2	583	36
		All	172		50.3	609	38
	Females	3	28	8.5		554	21
		4	60	18.1		594	22
		5	75	22.7		612	24
		Unknown	7		2.0	588	13
		All	170		49.7	595	30
	All fish	3	64		18.7	565	31
		4	119		34.8	601	28
		5	148		43.3	620	28
		Unknown	11		3.2	586	22
		All	342		100.0	602	35
Adipose only	Females	3	0				
		4	1		100.0	540	0
		5	0				
		6	0				
		Unknown	0				
		All	1		100.0	540	0
	Males	All	0				

(Continued)

Table 13. Age, sex and length statistics of marked and unmarked adult chum salmon dead-pitched from the spawning channel, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose Right Ventral	Females	3	2	66.7		545	35
		4	1	33.3		590	0
		5	0				
		6	0				
		Unknown	0				
		All	3		100.0	560	36
	Males	All	0				
Adipose Left Ventral	Males	3	0				
		4	1	25.0		605	0
		5	2	50.0		608	46
		6	0				
		Unknown	0				
		All	3		60.0	607	33
	Females	3	0				
		4	0				
		5	1	25.0		595	0
		6	0				
		Unknown	1		20.0	655	0
		All	2		40.0	625	42

(Continued)

Table 13. Age, sex and length statistics of marked and unmarked adult chum salmon dead-pitched from the spawning channel, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose Left Ventral	All fish	3	0				
		4	1		20.0	605	0
		5	3		60.0	603	33
		6	0				
		Unknown	1		20.0	655	0
		All	5		100.0	614	33
Marked and unmarked	Males	3	36	10.6		574	34
		4	60	17.7		608	32
		5	75	22.1		628	30
		6	0				
		Unknown	4		1.1	583	36
		All	175		50.0	609	38
	Females	3	30	8.8		553	22
		4	62	18.3		593	23
		5	76	22.4		611	24
		6	0				
		Unknown	7		2.0	588	13
		All	175		50.0	594	31

(Continued)

Table 13. Age, sex and length statistics of marked and unmarked adult chum salmon dead-pitched from the spawning channel, 1974. (Concluded)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Marked and unmarked	All fish	3	66		18.9	565	31
		4	122		34.9	600	28
		5	151		43.1	620	28
		6	0				
		Unknown	11		3.1	586	22
		All	350		100.0	602	35

[a]Number sampled as a percent of the total number of fish sampled with a given fin-mark.

Equation: Sum (no. fish x average no. eggs retained)
= total number of eggs retained in the sample.

Therefore: (94 x 125) + (5 x 375) + (1 x 1,250)
= 14,875 eggs.

2) Fecundity: regression equation (calculated values derived from combined 1960 - 1973 data).

Equation: -2,089 + (9.15 x mean length in mm)
= average no. of eggs produced per female.

Therefore: -2,089 + (9.15 x 604) = 3,438 eggs per female

And: 3,438 x 100 fish = 343,800 eggs produced by sampled 100 females

3) Percent egg retention:

Equation: No. eggs retained /(no. eggs produced) x 100

Therefore: (14,875 / 343,800) x 100
= 4.3%

Above the main fence

Females accounted for 2,382 (45.2%) of the total 5,270 adults live-sampled at the main fence (Table 9). Applying this percentage to the total escapement above the fence of 80,969 fish, an estimated 36,598 were females. Because 9,933 females were known to have spawned in the spawning channel (Table 12), it is assumed that the remaining 26,665 females were present in the river.

As calculated above, the average fecundity was 3,438 eggs per female. This value multiplied by the estimated number of female spawners above the fence (26,665), indicates a potential deposition of 91,674,270 eggs. Reducing this figure by 4.3% to allow for egg retention, results in an estimated deposition of 87,732,276 eggs in the river above the main fence.

Below the main fence

For the purpose of this report, it is assumed that the sex-ratio, mean length, mean fecundity and average egg retention as established above, also applied to those females spawning below the fence.

Therefore, of the estimated 15,427 fish that spawned below the fence (Table 5), 45.2% or 6,973 were females. Multiplying this number by the mean fecundity value of 3,438 eggs per fish, indicates that the potential production was 23,973,174 eggs. Allowing for an average egg retention of 4.3%, an estimated 22,942,328 eggs were deposited in the river below the main fence.

Spawning channel

As determined by the dead-pitch count, a total of 9,933 females spawned in the channel (Table 12). The mean length of 175 sampled females was 594 mm (Table 13). As previously stated, egg retention in this group was 13.2%. Applying the regression equation for fecundity defined above, the average production of each female in the channel was 3,346 eggs. The potential egg production therefore, was 33,235,818 and the estimated deposition in the spawning channel was 28,848,690 eggs.

A summary of egg deposition data reveals that of the 96,396 chum adults in the system, 43,571 (45.2%) were females (Table 14). The total potential production was 148,883,262 eggs, and the estimated egg deposition was 139,523,294.

Table 14. Summary of chum egg deposition calculations, Big Qualicum River system,1974.

River area	Number of fish	Number of females	Mean length (mm)	Mean fecundity (eggs/fish)	Potential production (number of eggs)	Egg retention (%)	Estimated deposition (number of eggs)
Above the main fence	59,860	26,665	604	3,438	91,674,270	4.3	87,732,276
Below the main fence	15,427	6,973	604	3,438	23,973,174	4.3	22,942,328
Subtotal	75,287	33,638	604	3,438	115,647,444	4.3	110,674,604
Spawning channel	21,109	9,933	594	3,346	33,235,818	13.2	28,848,690
Grand total	96,396	43,571	-	-	148,883,262	-	139,523,294

CHUM FRY

CATCHABILITY TESTS AND SAMPLING

From March 1 to June 19, 1975, a daily enumeration of the downstream migration of chum fry was conducted at the new fence (hub 297) (Fig. 1). Because the traps located at the new fence did not catch all the fry, it was necessary to determine what fraction of the migration was actually trapped. Therefore, catchability tests were conducted from April 12 to May 5 to provide the required factor.

Fry were collected at the main fence (hub 290), marked with Bismark brown-yellow dye, and kept in a live-box overnight. Upon removal of the dead and injured fish, the fry were counted and released the next day. As they continued their migration downstream, a portion was recaptured by the traps at the new fence (Table 15). The number of marked fish released (26,237) divided by the number of marked fish recaptured (1,072) provided a catchability coefficient of 25. This factor was then used to determine the total downstream migration of chum fry.

From the adjusted daily counts, i.e. actual observations multiplied by the catchability coefficient, an estimated 64,354,125 chum fry migrated downstream through the new fence in the spring of 1975 (Table 16). The peak migration occurred during the first part of May (Fig. 4).

From April 2 to June 4, 1975, weekly samples were taken at the main fence to provide length and weight data (Table 17). Using these data, a mean condition coefficient of 0.607 was established for the sample.

PRODUCTION AND SURVIVAL RATES

Spawning channel

Hydraulic sampling was carried out in various sections of the spawning

Table 15. Chum fry catchability tests,1975. (Marked fish were released at the main fence and recaptured at the new fence.)

Release date	Number released	Number recaptured
April 12	1,488	59
14	1,764	72
15	2,391	89
16	1,904	75
17	2,159	86
18	2,132	87
19	2,192	103
20	2,142	88
22	2,032	67
23	1,998	80
28	2,023	85
30	2,005	90
May 5	2,007	91
Total	26,237	1,072

Table 16. Daily estimated enumeration of the downstream migration of chum fry at the new fence, 1975.

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
March 1	325	325	
2	275	600	
3	300	900	
4	275	1,175	
5	225	1,400	
6	525	1,925	
7	575	2,500	
8	625	3,125	
9	625	3,750	
10	900	4,650	
11	1,100	5,750	
12	1,650	7,400	
13	2,200	9,600	
14	2,300	11,900	
15	2,425	14,325	
16	3,575	17,900	
17	4,900	22,800	
18	6,075	28,875	
19	5,275	34,150	0.1
20	4,475	38,625	0.1
21	4,900	43,525	0.1
22	5,125	48,650	0.1
23	5,325	53,975	0.1
24	5,450	59,425	0.1
25	5,525	64,950	0.1
26	4,500	69,450	0.1
27	3,525	72,975	0.1
28	5,300	78,275	0.1
29	6,900	85,175	0.1
30	8,100	93,275	0.1
31	6,150	99,425	0.2
April 1	10,200	109,625	0.2
2	10,300	119,925	0.2
3	12,850	132,775	0.2
4	16,075	148,850	0.2
5	18,175	167,025	0.2
6	21,600	188,625	0.3
7	22,650	211,275	0.3
8	24,450	235,725	0.4
9	25,800	261,525	0.4
10	27,000	288,525	0.4

(Continued)

Table 16. Daily estimated enumeration of the downstream migration of chum fry at the new fence, 1975. (Continued)

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
April 11	41,775	330,300	0.5
12	44,750	375,050	0.6
13	52,925	427,975	0.7
14	46,375	474,350	0.7
15	63,025	537,375	0.8
16	93,650	631,025	1.0
17	132,850	763,875	1.2
18	129,250	893,125	1.4
19	165,275	1,058,400	1.6
20	167,575	1,225,975	1.9
21	183,300	1,409,275	2.2
22	243,600	1,652,875	2.6
23	149,500	1,802,375	2.8
24	181,350	1,983,725	3.1
25	99,000	2,082,725	3.2
26	376,850	2,459,575	3.8
27	963,125	3,422,700	5.3
28	803,675	4,226,375	6.6
29	866,700	5,093,075	7.9
30	1,080,025	6,173,100	9.6
May 1	1,161,425	7,334,525	11.4
2	1,240,325	8,574,850	13.3
3	1,405,675	9,980,525	15.5
4	1,260,975	11,241,500	17.5
5	1,613,050	12,854,550	20.0
6	2,066,825	14,921,375	23.2
7	2,037,525	16,958,900	26.4
8	2,677,150	19,636,050	30.5
9	3,259,825	22,895,875	35.6
10	4,653,750	27,549,625	42.8
11	3,857,700	31,407,325	48.8
12	3,762,700	35,170,025	54.7
13	3,439,950	38,609,975	60.0
14	2,797,925	41,407,900	64.3
15	2,931,425	44,339,325	68.9
16	1,856,625	46,195,950	71.8
17	1,697,050	47,893,000	74.4
18	1,615,425	49,508,425	76.9
19	1,306,975	50,815,400	79.0
20	1,329,875	52,145,275	81.0

(Continued)

Table 16. Daily estimated enumeration of the downstream migration of chum fry at the new fence, 1975. (Concluded)

Date		Daily migration[a]	Cumulative migration	Percent cumulative migration
May	21	1,407,500	53,552,775	83.2
	22	1,597,250	55,150,025	85.7
	23	390,825	55,540,850	86.3
	24	1,338,050	56,878,900	88.4
	25	1,349,450	58,228,350	90.5
	26	418,500	58,646,850	91.1
	27	1,385,250	60,032,100	93.3
	28	1,085,425	61,117,525	95.0
	29	865,675	61,983,200	96.3
	30	602,425	62,585,625	97.3
	31	520,700	63,106,325	98.1
June	1	370,550	63,476,875	98.6
	2	264,125	63,741,000	99.0
	3	240,800	63,981,800	99.4
	4	133,475	64,115,275	99.6
	5	83,950	64,199,225	99.8
	6	45,225	64,244,450	99.8
	7	43,900	64,288,350	99.9
	8	24,525	64,312,875	
	9	13,900	64,326,775	
	10	9,000	64,335,775	
	11	6,625	64,342,400	
	12	2,425	64,344,825	
	13	3,675	64,348,500	
	14	1,900	64,350,400	
	15	1,400	64,351,800	
	16	775	64,352,575	
	17	150	64,352,725	
	18	725	64,353,450	
	19	675	64,354,125	100.0

[a]Daily migration is the result of multiplying the actual daily count by the catchability coefficient of 25.

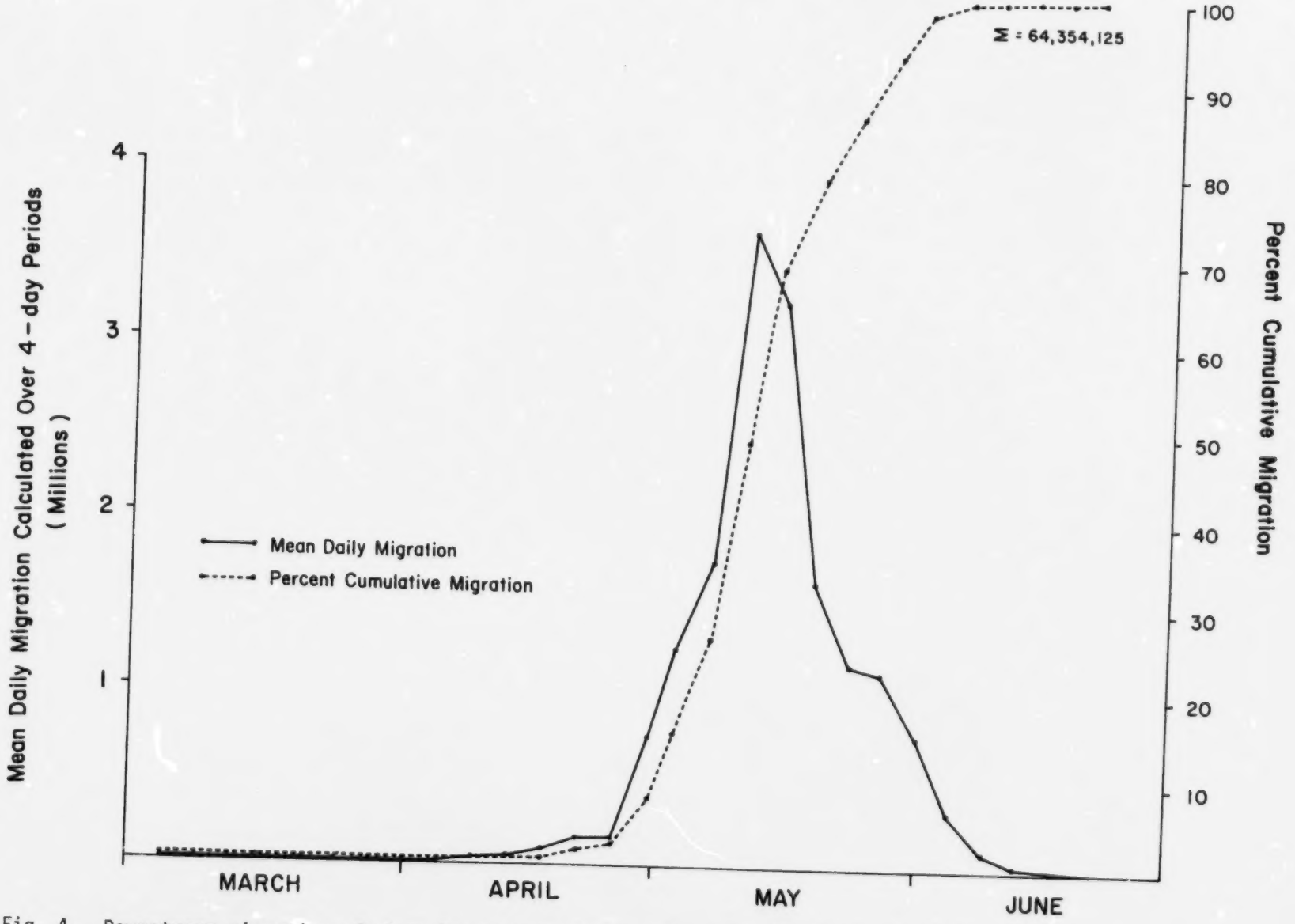

Fig. 4. Downstream migration of chum fry through the new fence of the Big Qualicum River, 1975.

Table 17. Length, weight and condition coefficient statistics of chum fry trapped at the new fence, 1975.

Date	Number sampled	Length (mm)		Weight (g)		Condition coefficient[a]
		Mean	Standard deviation	Mean	Standard deviation	
April 2	99	38	1.4	.36	.04	.656
9	100	38	1.5	.34	.04	.620
16	100	39	1.5	.36	.04	.607
23	100	39	1.6	.35	.04	.590
30	100	40	1.6	.37	.05	.578
May 7	100	39	1.7	.36	.04	.607
14	100	40	1.5	.38	.04	.594
21	100	39	1.9	.36	.06	.607
30	100	39	1.5	.36	.05	.607
June 4	100	40	1.6	.37	.04	.578
Overall	999	39	1.7	.36	.05	.607

[a] Condition coefficient = weight x 10^5 / length^3.

channel (Fig. 2) to determine the percent survival from the egg to the fry stage. The results of the sampling indicated a mean survival rate of 78.2% to the alevin stage (Table 18). A comparison of similar studies, from previous years when fry were enumerated at the outlet of the channel, revealed that egg-to-fry survival was consistently two percent lower than egg-to-alevin survival. This difference has been attributed to alevin mortality. Therefore, it can be assumed that of the estimated 28,848,690 eggs deposited in the spawning channel (Table 14), 76.2% or 21,982,702 survived to the fry stage.

Above and below the new fence

As mentioned previously, the total estimated downstream migration of chum fry was 64,354,125. Subtracting the number of fry produced in the spawning channel (21,982,702) from this total indicates that 42,371,423 fry were produced in the river above the new fence.

Before the percentage survival of egg-to-fry can be determined a slight recalculation of the data is necessary. A total of 22,942,328 eggs were deposited below the main fence (Table 14). From the fish distribution data (Table 4), it was calculated that of the 33,425 adults which spawned below the main fence, 30,922 (92.5%) spawned between the new fence (hub 297) and the main fence (hub 290). Applying this percentage to the total number of eggs deposited below the main fence (22,942,328), reveals that an estimated 21,221,653 eggs were deposited between the fences. The sum of this value plus the total number of eggs deposited above the main fence (87,732,276) (Table 14), indicates that a total of 108,953,929 eggs were deposited above the new fence. Further, by subtracting the number of eggs deposited between the fences (21,221,653) from the total number deposited below the main fence (22,942,328) results in an estimated deposition of 1,720,675 eggs below the new fence.

The percent survival therefore, of egg-to-fry above the new fence is

Table 18. Egg-to-alevin survival of chum salmon in the spawning channel, 1975.

Date	Sample location (section)	Live		Dead		% survival
		Eggs	Alevins[a]	Eggs	Alevins	
April 7	2	1	542	729	3	42.6
7	4	0	940	231	1	80.2
7	5		716	209		77.4
8	8		285	127		69.2
8	9		1,061	64		94.3
8	12		1,219	121	1	90.9
8	13		496	109		82.0
8	16		354	78		81.9
8	17		680	194		77.8
8	19		647	73		89.9
Total		1	6,940	1,935	5	78.2

[a]Includes 1,091 coho alevins.

determined by dividing the estimated fry production (42,371,423) by the total egg deposition (108,953,929) and multiplying by 100. Applying the resulting survival rate (38.9%) to the egg deposition below the new fence (1,720,675), indicates that a total of 669,343 fry were produced in that area.

In summary then, the total fry production of the 1974 brood chum salmon from the Big Qualicum River was 65,023,468 (Table 19).

MARKING PROGRAM

Between April 21 and May 9, 1975, a total of 111,948 chum fry of both river and spawning channel origin, were trapped at the new fence and marked with an adipose and right ventral fin-clip (Table 20). Of these, 398 died resulting in a total release of 111,550 marked fry (Table I).

Table 19. Summary of the estimated chum fry production and egg-to-fry survival rates,1975.

River area	Number of eggs deposited	Number of fry produced	Egg-to-fry survival
Above the new fence	108,953,929	42,371,423	38.9%
Below the new fence	1,720,675	669,343	38.9%
Subtotal	110,674,604	43,040,766	38.9%
Spawning channel	28,848,690	21,982,702	76.2%
System	139,523,294	65,023,468	46.6%

Table 20. Summary of released chum fry marked with an adipose and right ventral fin-clip,1975.

Date	Number of fish	Cumulative marked	Daily mortality	Cumulative mortality
April 21	7,725	7,725	25	25
22	7,925	15,650	18	43
23	4,370	20,020	23	66
24	7,112	27,132	17	83
25	4,604	31,736	19	102
28	8,984	40,720	21	123
29	9,040	49,760	21	144
30	9,145	58,905	16	160
May 1	6,031	64,936	37	197
2	5,975	70,911	42	239
5	9,350	80,261	27	266
6	9,212	89,473	29	295
7	7,548	97,021	31	326
8	9,055	106,076	39	365
9	5,872	111,948	33	398

ANALYSIS OF MARKED CHUM RETURNS

The marking of chum fry in the Big Qualicum River was initiated in 1966. The purpose of this continuing program is twofold: first, to determine the number of Big Qualicum chum caught commercially; and second, to evaluate the success of the spawning channel.

In the 1974 adult chum returns, six different mark-types were evident. An adipose and left ventral (AD/LV) clip indicated the fish were of river origin, and an adipose and right ventral (AD/RV) clip represented spawning channel origin. Fish with an adipose and anal (AD/AN) clip were from the 1969 brood that had been held in the rearing channel and fed for 45 days. Three of the six mark-types were single clips and were interpreted as follows: a left ventral clip was assumed to be adipose and left ventral; a right ventral clip was considered to be adipose and right ventral; and those fish with an adipose-only mark were not assigned.

The following analysis of the return is divided into three major sections. The first involves the age and origin of the escapement; the second, the age and origin of the commercial catch; and the third, the survival of the 1969 brood.

AGE AND ORIGIN OF THE 1974 ESCAPEMENT

Fin-mark incidence

Adult salmon were not sampled at the main fence on November 17, November 29 and December 15 (Table 10). The escapement on these days however, was 3,403, 394 and 385 respectively. The sum of these counts (4,182) was subtracted from the total representative escapement (77,780) to determine that 73,598 adults passed through the main fence during the actual sampling period. Daily adjustment factors were applied to the numbers of marked fish in the

sample to provide the estimated incidence of fin-marks in this portion of the escapement. Of the 73,598 adults, 1,102 had an AD/LV mark, 797 had an AD/RV mark, and 61 had an AD/AN mark.

A factor for determining the estimated number of marked fish in the total upstream migration of 96,396 chum (Table 7) was established by dividing the total escapement by that portion which passed through the fence during sampling (73,598). The resulting factor (1.3098), multiplied by each of the above figures, reveals that the fin-mark incidence in the total escapement was 1,443 AD/LV, 1,044 AD/RV and 80 AD/AN. The remaining 93,829 adults were either unmarked or unassigned, i.e. some fish could have had adipose-only marks.

Age composition

The precent age composition of fish of known age (Table 11) has been applied to the fin-mark incidence determined above to provide the age composition of the adults in the total escapement (Table 21).

Origin

In general, marked fry suffer a greater mortality than do unmarked fry. Therefore, the ratio of marked-to-unmarked adults is lower than the ratio of marked-to-unmarked fry. Accordingly, an adjustment in the number of adult marks is required to account for this mortality factor. In an unpublished report, M. Bailey indicated that 20 percent is a realistic figure for mark mortality.

Using this information, the number of unmarked 5 years olds (1969 brood) in the total 1974 escapement, that had been reared experimentally in freshwater, was calculated as follows:

Table 21. Age composition of marked and unmarked adult chum salmon in the 1974 escapement.

Mark	Origin	Brood year	Age (years)	Sample size [a]	% age composition	Number of fish
AD/LV	River	1971	3	0	0	0
		1970	4	46	58.2	840
		1969	5	32	40.5	584
		1968	6	1	1.3	19
AD/RV	Spawning channel	1971	3	8	15.4	161
		1970	4	16	30.8	321
		1969	5	28	53.8	562
		1968	6	0	0	0
AD/AN	Freshwater reared	1969	5	3	100.0	80
		1968	6	0	0	0
Unmarked (includes Ad-only)	Unknown	1971	3	110	23.0	21,581
		1970	4	129	26.9	25,240
		1969	5	233	48.6	45,601
		1968	6	7	1.5	1,407
Marked and unmarked	All	1971-1968	3-6	613	100.0	96,396

[a] Sample size represents all aged fish from Table 11.

$$\text{no. of unmarked adults} = \frac{\text{no. of unmarked fry}}{\text{no. of marked fry}} \times \frac{\text{no. of marked adults}}{(100\%-20\%\ \text{mark mortality})}$$

Therefore: $$\frac{1,530,000}{70,958} \times \frac{80}{80\%} = 2,156 \text{ adults}$$

(Note that the fry values are from Table I and the adult value is from Table 21). For the 1974 escapement then, 2,156 chums were unmarked adults originating from the 1969 brood and reared in freshwater. Further, by subtracting this figure from the total number of unmarked adults (45,601) (Table 21), it can be concluded that the 43,445 unmarked 5 year olds, and indeed the remaining adults in the escapement originated from either the river or the spawning channel. This latter conclusion is based on the observation that of the total escapement, only the 80 adults noted in the equation above had been fresh-water reared.

In order to assign the 43,445 unmarked adults to either river or spawning channel origin, a fry-to-adult survival rate for marked fish was applied to the unmarked fry population allowing for a 20 percent mark mortality. Hence, for each origin, the number of unmarked adults is equal to:

$$(\text{no. of marked adults} \times (100\% - 20\%)^{-1}) \times \frac{\text{no. of unmarked fry}}{\text{no. of marked fry}}$$

Dividing this equation using river values by the same equation using spawning channel values, cancels the mark mortality percentages, and results in a final ratio of the number of unmarked adults of river origin to the number of unmarked adults of spawning channel origin.

Summary

Substituting fry migration figures from Table I and adult age figures from Table 21, the above ratio can be applied to the unmarked fish of each age as follows:

Age 3 (1971 Brood)

Because fry from the spawning channel only were marked in 1971, the origin of this portion of the unmarked adults cannot be assigned.

Age 4 (1970 Brood)

$$\frac{\text{no. river unmarked adults}}{\text{no. spawn. chan. unmarked adults}} = \frac{840 \times 26{,}900{,}000}{900{,}000} \Big/ \frac{321 \times 19{,}800{,}000}{660{,}000}$$

$$= 2.6071$$

Age 5 (1969 Brood)

$$\frac{\text{no. river unmarked adults}}{\text{no. spawn. chan. unmarked adults}} = \frac{584 \times 40{,}600{,}000}{1{,}220{,}000} \Big/ \frac{562 \times 18{,}800{,}000}{680{,}000}$$

$$= 1.2508$$

Age 6 (1968 Brood)

The only 6 year old marked fish were AD/LV. Therefore all unmarked 6 year olds were assigned to the river.

The results of the application of these ratios to the unmarked portion of the escapement are presented in Table 22. A summary of the age and origin of both marked and unmarked adults in the 1974 escapement by various age groups is given (Table 23).

AGE AND ORIGIN OF THE 1974 COMMERCIAL CATCH

The 1974 commercial fishery for chum salmon was open September 29 to October 1, October 20 to October 22, and October 30 and 31 (Table II). The early fishery was not considered in the calculations presented below as the Big Qualicum chum stock has a later than average timing and presumably would account for a catch of only a few hundred during this period. The late fishery was concentrated in Areas 14 and 17 (Fig.5). Although it is probable that Big Qualicum chum were caught in this fishery, it has been excluded from the following analysis because of a lack of samples.

Fin-mark incidence

The October 20 to 22 fishery took place in Catch Areas 12 and 13, and resulted in a total catch of 113,896 chum salmon. Of these, 20,846 were sampled for age and fin-mark incidence. Catch-to-sample ratios were calculated for each

Table 22. Age and origin of unmarked adult chum salmon in the 1974 escapement.

Age: Brood year :	3 1971	4 1970	5 1969	6 1968	All
Area					
River	-	18,243	24,143	1,407	43,793
Spawning channel	-	6,997	19,302	-	26,299
Freshwater reared	-	-	2,156	-	2,156
Unassigned	21,581	-	-	-	21,581
System	21,581	25,240	45,601	1,407	93,829

Table 23. Summary of the age and origin of marked and unmarked adult chum salmon in the 1974 escapement.

Age: Brood year :	3 1971	4 1970	5 1969	6 1968	All
Area					
River	-	19,083	24,727	1,426	45,236
Spawning channel	161	7,318	19,864	-	27,343
Freshwater reared	-	-	2,236	-	2,236
Unassigned	21,581	-	-	-	21,581
System	21,742	26,401	46,827	1,426	96,396

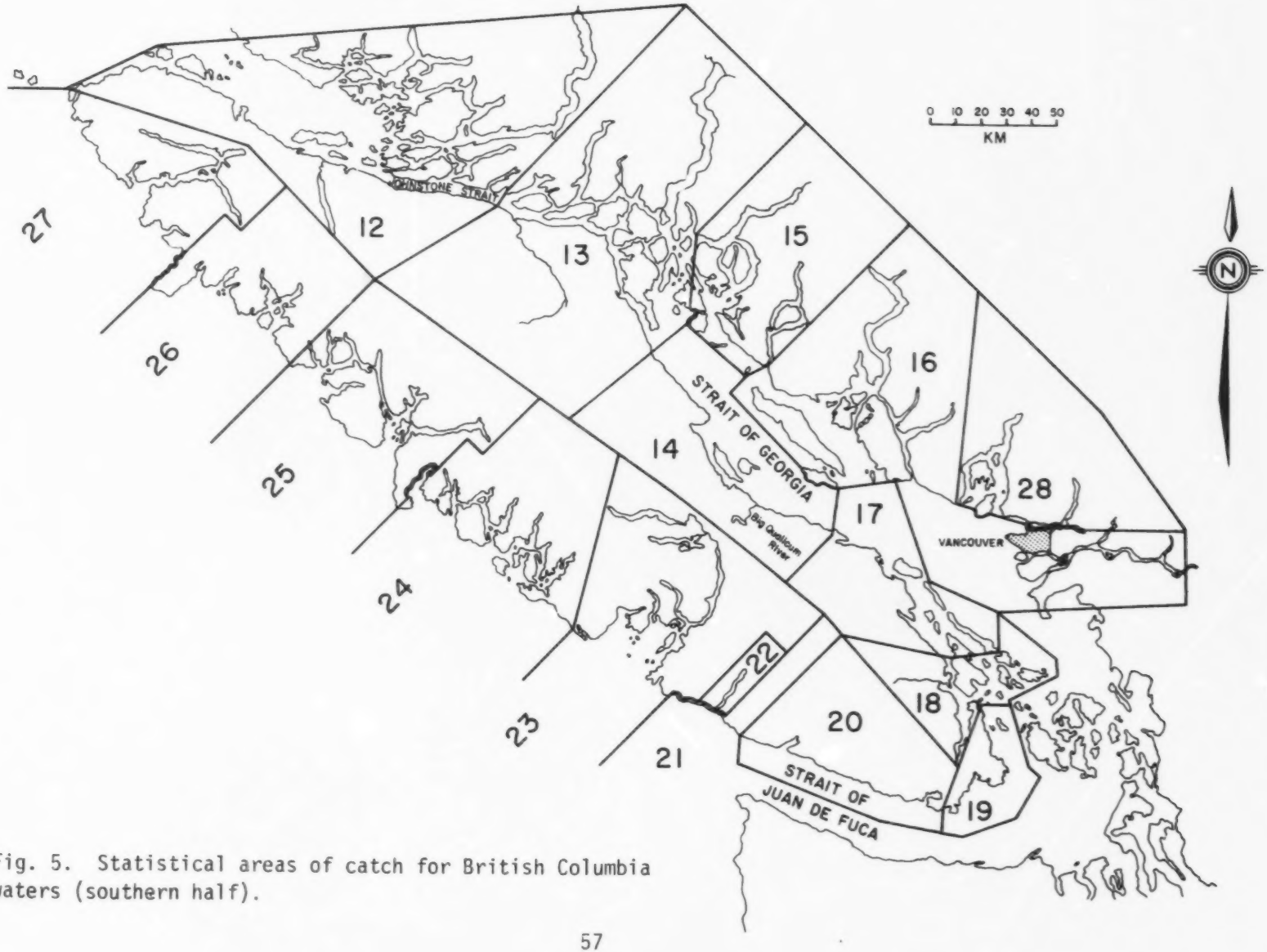

Fig. 5. Statistical areas of catch for British Columbia waters (southern half).

Area and extrapolated to provide the estimated fin-mark incidence for each age group in the total catch (Table 24). With these data, the number of chum salmon originating from the Big Qualicum River can be estimated.

Contribution of Big Qualicum chum salmon to the fishery

According to M. Bailey (pers. comm.) the proportion of marked fish in the run changes as the migration proceeds. Therefore the mark-rate specific to each catch (Table II) must be determined in order to calculate what number of unmarked fish is represented by each mark recovery. To this end, a method has been developed to determine the mark-rate of that portion of the Big Qualicum run which was subjected to exploitation but which was rot included in the commercial catch. Table III presents estimated migration times from each Catch Area to the main fence of the river. As indicated, it took roughly 40 days for the Big Qualicum chums representative of the October 20 to 22 fishery, to arrive at the main fence from Area 12. Allowing 7 days for dispersion, it is thought that this portion was counted through the fence from November 23 to November 29, 1974 (Table 25).

Thus, the mark-rate of the Area 12 fishery would be equal to that of the sampled fish (Table 25) and is calculated as follows:

$$\text{Mark-rate} = \frac{\text{number of marks in the Nov. 23 - 29 escapement}}{\text{total number of fish counted Nov. 23 - 29}}$$

$$= \frac{619}{22,339}$$

$$= 0.0277$$

Application of the mark-rate to the fin-mark incidence observed in the fishery in Area 12 (Table 24) provides the number of Big Qualicum chum salmon captured in this fishery:

$$\frac{\text{number of marks captured in Area 12}}{\text{mark-rate}}$$

$$= \frac{72}{.0277}$$

$$= .599$$

Table 24. Estimated fin-mark incidence in the 1974 commercial catch of Big Qualicum chum salmon (October 20 - 22).

Catch Area	Catch[a]	Sample[a]	Catch:sample ratio	Mark	Age 3	4	5	All
12	42,630	6,982	6.1:1	AD/RV	12	18	6	36
				AD/LV	-	24	12	36
				AD/AN	-	-	-	-
				All	12	42	18	72
13	71,266	13,864	5.1:1	AD/RV	31	31	15	77
				AD/LV	-	51	10	61
				AD/AN	-	-	5	5
				All	31	82	30	143
Both	113,896	20,846	-	AD/RV	43	49	21	113
				AD/LV	-	75	22	97
				AD/AN	-	-	5	5
				All	43	124	48	215

[a]From Table II.

Table 25. Estimated fin-mark incidence in adult chum salmon migrating through the main fence from November 23 to 29, 1974 (adapted from Table 10).

Date	Number of fish sampled	Daily escapement	Adjustment factor	Fin-mark incidence				
				AD/LV	AD/RV	AD/AN	All marks	Unmarked (includes AD-only)
Nov. 23	176	2,020	11.48	-	46	11	57	1,963
24	289	16,003	55.37	221	221	-	442	15,561
25	100	2,847	28.47	-	85	-	85	2,762
26	93	476	5.12	5	-	-	5	471
27	116	478	4.12	8	8	-	16	462
28	114	515	4.52	-	14	-	14	501
29	-	394	-	-	-	-	-	-
Total	888	22,339[a]	-	234	274	11	619	21,720

[a]As no fish were sampled on the 29th, 394 counted fish have not been included in this total.

Similarly, these data can be calculated for the Area 13 fishery. The representative portion of this fishery would have been counted through the fence 32 days later or between November 14 and 20 (Table III; Table 26). Hence, the mark-rate is equal to:

$$\frac{\text{number of marks in the Nov. 14 - 20 escapement}}{\text{total number of fish counted Nov. 14 - 20}}$$

$$= \frac{276}{9,292}$$

$$= 0.0297$$

And the number of Big Qualicum chum salmon caught in this fishery is equal to:

$$\frac{\text{number of marks captured in Area 13}}{\text{mark-rate}}$$

$$= \frac{143}{0.0297}$$

$$= 4,815$$

The total catch of Big Qualicum chum from the two Catch Areas during the October 20 to 22 fishery was 7,414 fish.

Age composition

Using the fin-mark data (Table 24, I), these fish can be aged. Mark-rates for fry were determined for the brood years 1969, 1970, 1971 without regard to origin (Table 27). By dividing the estimated fin-mark incidence for each age group by the respective mark-rates for fry, the percent age composition and hence the age of the Big Qualicum chum salmon in the fishery have been determined. Of the total 7,414 fish, 1,683 were 3 year olds, 4,093 were 4 year olds, and 1,638 were 5 year olds (Table 28).

Origin

There were five fish in the catch with an AD/AN clip (Table 24). This clip indicates that these 5 year old fish (1969 brood year) had been reared in freshwater (Table I). In order to determine the total number of freshwater-

Table 26. Estimated fin-mark incidence in adult chum salmon migrating through the main fence from November 14 to 20, 1974. (Adapted from Table 10).

Date	Number of fish sampled	Daily escapement	Adjustment factor	Fin-mark incidence				
				AD/LV	AD/RV	AD/AN	All marks	Unmarked (includes AD-only)
Nov. 14	90	567	6.30	19	-	-	19	548
15	52	957	18.40	18	-	-	18	939
16	122	1,141	9.35	9	19	-	28	1,113
17	-	3,403	-	-	-	-	-	-
18	207	5,514	26.64	80	27	27	134	5,380
19	40	918	22.95	46	-	23	69	849
20	24	195	8.13	-	8	-	8	187
Total	535	9,292[a]		172	54	50	276	9,016

[a]As no fish were sampled on the 17th, 3,403 counted fish have not been included in this total.

Table 27. Fin-mark incidence (in millions) and mark-rates of fry used to determine the age of Big Qualicum chum salmon in the 1974 commercial catch (adapted from Table I).

Mark	Age (brood year)		
	3 (1971)	4 (1970)	5 (1969)
AD/LV	-	0.900	1.220
AD/RV	0.970	0.660	0.680
AD/AN	-	-	0.070
All	0.970	1.560	1.970
Unmarked	35.600	46.700	60.900
Total	36.600	48.200	63.000
Mark-rate[a]	0.027	0.032	0.031

[a]Mark-rate = number of fry marked / total fry marked and unmarked.

Table 28. Estimated ages of Big Qualicum chum in the commercial catch from Areas 12 and 13 in the October 20-22, 1974 fishery.

Age (Brood year)	Mark incidence in catch[a]	Mark-rate of fry[b]	Number of fish[c]	Age composition (%)	Number of Big Qualicum chum in catch
3 (1971)	43	0.027	1,593	22.7	1,683
4 (1970)	124	0.032	3,875	55.2	4,093
5 (1969)	48	0.031	1,548	22.1	1,638
Total	215	-	7,016	100.0	7,414

[a]From Table 24.

[b]From Table 27.

[c]Number of fish = mark incidence / mark-rate.

Table 29. Summary of the age and origin of Big Qualicum chum salmon caught in the commercial fishery during October 20 to 22, 1974.

	Age (brood year)			
Area	3 (1971)	4 (1970)	5 (1969)	All
River	-	2,467	833	3,300
Spawning channel	43	1,626	664	2,333
Freshwater reared	-	-	141	141
Unassigned	1,640	-	-	1,640
System	1,683	4,093	1,638	7,414

reared chum salmon in the catch, the following equation has been used:

$$\frac{\text{number of fry out}}{\text{number of fry marked}} \times \frac{\text{number of marked adults}}{(100\% - 20\% \text{ mark mortality})}$$

$$= \frac{1,600,000}{70,958} \times \frac{5}{0.8}$$

$$= 141$$

(Note that the fry values are from Table I and the adult value is from Table 24. The 20% mark mortality was discussed previously).

Of the estimated 1,638 five year old Big Qualicum chum salmon in the commercial catch, 141 had been reared in freshwater. Further, the remaining 1,497 five year olds as well as all of the 3 and 4 year olds were either of spawning channel or river origin. In order to assign these remaining fish to the appropriate origin, the following ratio was devised:

river - origin : spawning channel origin

$$= \left(\frac{\text{number of river fry} \times \text{number of marked river adults}}{\text{number of marked river fry}}\right) / \left(\frac{\text{number of channel fry} \times \text{number of marked channel adults}}{\text{number of marked channel fry}}\right)$$

Summary

Substituting fry values from Table I and adult values from Table 24, this ratio can be applied to the fish in each age group as follows:

Age 3 (1971 Brood)

Because fry from the spawning channel only were marked in 1971, the origin of this portion of the catch cannot be assigned. It has been estimated however, that there were 43 chum with an AD/RV mark in the fishery (Table 24). These, therefore have been assigned to spawning channel origin.

Age 4 (1970 Brood)

number of river-origin adults : number of channel-origin adults

$$= \frac{27,700,000 \times 75}{900,000} \quad / \quad \frac{20,500,000 \times 49}{660,000}$$

$$= 1.5167$$

Age 5 (1969 Brood)

number of river-origin adults : number of channel-origin adults

$$= \frac{41,900,000 \times 22}{1,220,000} \quad / \quad \frac{19,500,000 \times 21}{680,000}$$

$$= 1.2547$$

The results of the application of these ratios to the total number of fish in each age group as determined above are presented in Table 29.

SURVIVAL OF THE 1969 BROOD

Analyses, similar to those shown above, have also been made using 1972 and 1973 escapement and commercial catch data. Summaries of the results for all three years of data are provided (Tables IV, V). The survival of Big Qualicum adult chum salmon is given in Table 30. Those data pertaining to the 1969 brood year have been extracted from the table and used to determine the fry-to-adult survival rate for each origin (Table 31). The survival rate was highest for those chum reared in freshwater. Salmon of spawning channel origin obtained a higher survival rate than did those of river origin. Although not evident from the table, it was observed that among the 4 year olds, those fish originating from the spawning channel returned at a later age than did those from the river. For example, the average age of returning spawning channel fish was 4.10 years, while that of

the river fish was 4.04 years. In addition, 4 year olds from the spawning channel were slightly but significantly shorter than those from the river (Table 32).

Table 30. Summary of Big Qualicum chum salmon survival as determined from escapement and commercial catch data from 1972 to 1974.

Return year	Age (years)	Brood year	Origin				
			River	Spawning channel	Freshwater reared	Unassigned	All sources
1972	3	1969	13,543	6,690	-	-	20,233
	4	1968	130,974	73,313	9,418	-	213,705
	5	1967	6,298	4,463	-	-	10,761
	All		150,815	84,466	9,418	-	244,699
1973	3	1970	1,304	-	-	-	1,304
	4	1969	240,823	110,234	12,692	-	363,749
	5	1968	56,936	28,939	1,233	-	87,108
	6	1967	-	-	-	316	316
	All		299,063	139,173	13,925	316	452,477
1974	3	1971	-	204	-	23,221	23,425
	4	1970	21,550	8,944	-	-	30,494
	5	1969	25,560	20,528	2,377	-	48,465
	6	1968	1,426	-	-	-	1,426
	All		48,536	29,676	2,377	23,221	103,810

Table 31. Survival rates of the 1969 Big Qualicum chum fry.

Origin	Number of fry out [a]	Age of returning adults				Percent Survival
		3	4	5	All	
River	41,900,000	13,543	240,823	25,560	279,926	0.67
Spawning channel	19,500,000	6,690	110,234	20,528	137,452	0.70
Freshwater reared	1,600,000	-	12,692	2,377	15,069	0.94
System	63,000,000	20,233	363,749	48,465	432,447	0.69

[a]From Table I.

Table 32. Mean length of 4 year old chum salmon produced from the 1969 brood.

Fin-mark	Origin	Number of fish	Length (mm)	
			Mean	Standard deviation
AD/LV	River	111	602	27
AD/RV	Spawning channel	52	588	23
AD/AN	Freshwater reared	6	593	13
Unmarked	System	538	600	24

CHINOOK

ENUMERATION AND SAMPLING OF ADULTS AND JACKS

The chinook salmon run began September 10, and ended November 14, 1974. A total of 554 adults (Table 33) and 211 jacks (Table 34) were counted at the main fence (Hub 290).

The returning chinook were handled in several different ways. Altogether, 120 adults and 17 jacks were permitted to pass through the main fence, and continued upstream. These fish were not sexed or examined for marks.

The remaining fish were trapped at the main fence, checked for marks and divided into 3 groups. The first group consisted of 56 unmarked adults and 133 unmarked jacks. These were released upstream after 120 were sampled for length. A total of 176 adults and 150 jacks therefore, dispersed upstream of the main fence.

The second group of trapped fish consisted of 378 adults which were used as hatchery brood stock. Upon completion of egg-take, the fish were aged, sexed and measured for length. In addition, all fish with adipose fin-marks were checked for coded-wire tags which were removed and read. Of the 378 adults, 296 (78.3%) were males and 82 (21.7%) were females. This ratio was considered to be representative of the total run of 554 adults.

The third group consisted of 57 adipose-marked jacks which were sampled for length and coded-wire tags.

The mean length of 496 males was 538 mm; of 82 females, 716 mm (Table 35). Of the total sample, 27% were 2 year olds, 51% were 3 year olds, 11% were 4 year olds, 2% were 5 year olds and 10% were of unknown age (Table 35). A summary of sex and length measurements of marked and unmarked adults is given in Table 36.

Table 33. Daily enumeration of the upstream migration of adult chinook salmon at the main fence, 1974.

Date	Daily count	Cumulative migration	Percent cumulative migration
Sept. 10	75	75	13.5
12	11	86	15.5
13	8	94	17.0
14	4	98	17.7
17	21	119	21.5
18	19	138	24.9
19	1	139	25.1
27	20	159	28.7
28	34	193	34.8
29	3	196	35.4
30	1	197	35.6
Oct. 1	2	199	35.9
2	3	202	36.5
3	1	203	36.6
4	1	204	36.8
5	4	208	37.5
6	6	214	38.6
7	3	217	39.2
8[a]	0	194	35.0
9	1	195	35.2
10	8	203	36.6
11	27	230	41.5
12	117	347	62.6
13	38	385	69.5
14	10	395	71.3
15	18	413	74.5
16	14	427	77.1
17	4	431	77.8
18	6	437	78.9
19	4	441	79.6
20	19	460	83.0
21	5	465	83.9
22	13	478	86.3
23	3	481	86.8
24	2	483	87.2
25	1	484	87.4
26	2	486	87.7
27	11	497	89.7
28	10	507	91.5
29	2	509	91.9
30	3	512	92.4
31	4	516	93.1

(Continued)

Table 33. Daily enumeration of the upstream migration of adult chinook salmon at the main fence, 1974. (Concluded)

Date	Daily count	Cumulative migration	Percent cumulative migration
Nov. 1	8	524	94.6
2	1	525	94.8
3	2	527	95.1
4	2	529	95.5
5	3	532	96.0
6	2	534	96.4
7	6	540	97.5
8	3	543	98.0
9	4	547	98.7
10	2	549	99.1
11	2	551	99.5
13	2	553	99.8
14	1	554	100.0

[a]Holding pond sort indicated a loss of 23 fish.

Table 34. Daily enumeration of migrating chinook jacks at the main fence,1974.

Date	Daily count	Cumulative count	Percent cumulative migration
Sept. 10	14	14	6.6
11	0	14	6.6
12	4	18	8.5
13	7	25	11.8
14	4	29	13.7
17	6	35	16.6
18	3	38	18.0
27	13	51	24.2
28	14	65	30.8
29	1	66	31.3
30	6	72	34.1
Oct. 1	5	77	36.5
2	7	84	39.8
3	1	85	40.3
4	2	87	41.2
5	3	90	42.7
6	1	91	43.1
7	9	100	47.4
8	4	104	49.3
9	4	108	51.2
10	13	121	57.3
11	23	144	68.2
12	23	167	79.1
13	10	177	83.9
14	3	180	85.3
16	6	186	88.2
17	7	193	91.5
18	2	195	92.4
19	5	200	94.8
20	2	202	95.7
21	2	204	96.7
22	1	205	97.2
24	1	206	97.6
25	1	207	98.1
26	1	208	98.6
27	3	211	
28	1	212	
30	1	213	
Nov. 9[a]	1	211	100.0

[a]A final sort showed a discrepancy loss of 3 enumerated jacks.

Table 35. Age, sex and length statistics of marked and unmarked adult and jack chinook salmon sampled at the main fence,1974.

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Unmarked	Males	2	101	31.86		413.27	28.60
		3	127	40.06		609.13	48.89
		4	25	7.89		670.60	61.36
		5	1	0.32		860.00	0
		Unknown	43		11.62	477.56	115.57
		All	297		80.27	529.49	115.17
	Females	2	0				
		3	21	6.62		642.62	50.59
		4	33	10.41		740.45	63.94
		5	9	2.84		796.67	61.95
		Unknown	10		2.70	758.00	56.97
		All	73		19.73	721.64	78.93
	All fish	2	101		27.30	413.27	28.60
		3	148		40.00	613.89	50.30
		4	58		15.68	710.34	71.40
		5	10		2.70	803.00	61.74
		Unknown	53		14.32	530.47	153.69
		All	370		100.00	567.41	133.12

(Continued)

Table 35. Age, sex and length statistics of marked and unmarked adult and jack chinook salmon sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose only	Males	2	7	24.14		416.43	27.65
		3	20	68.97		590.50	46.22
		4	2	6.90		710.00	21.21
		5	0				
		Unknown	4		12.12	462.50	109.13
		All	33		100.00	545.30	100.02
	Females	All	0				
Adipose and coded-wire tags							
Brown, blue ('71 Brood)	Males	3	90	93.75	93.75	599.72	47.50
	Females	3	6	6.25	6.25	658.33	59.64
	All fish	3	96	100.00	100.00	603.39	50.04
Green, ox. yellow ('71 Brood)	Males	3	24	88.89	88.89	628.96	44.70
	Females	3	3	11.11	11.11	690.00	8.66
	All fish	3	27	100.00	100.00	635.74	46.43

(Continued)

Table 35. Age, sex and length statistics of marked and unmarked adult and jack chinook salmon sampled at the main fence,1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose and coded-wire tags							
Lt. green, red ('72 Brood)	Males	2	16	100.00	100.00	429.69	23.56
Lt. green yellow ('72 Brood)	Males	2	17	100.00	100.00	415.00	31.97
Lt. green, blue ('72 Brood)	Males	2	2	100.00	100.00	412.50	31.82
Lt. green, orange ('72 Brood)	Males	2	4	100.00	100.00	447.50	55.45
Orange, lt. green ('72 Brood)	Males	2	6	100.00	100.00	420.83	13.57
Purple ('72 Brood)	Males	2	5	100.00	100.00	408.00	22.80

(Continued)

Table 35. Age, sex and length statistics of marked and unmarked adult and jack chinook salmon sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose Right Ventral	Males	2	0				
		3	1	100.00		655.00	0
		4	0				
		5	0				
		Unknown	0				
		All	1		100.00	655.00	0
	Females	All	0				
Left Ventral	Males	2	0				
		3	0				
		4	1	100.00		790.00	0
		5	0				
		Unknown	0				
		All	1		100.00	790.00	0
	Females	All	0				

(Continued)

Table 35. Age, sex and length statistics of marked and unmarked adult and jack chinook salmon sampled at the main fence,1974. (Concluded)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Marked and unmarked	Males	2	158	30.33		416.24	28.35
		3	262	50.29		606.47	48.87
		4	28	5.37		677.68	62.88
		5	1	0.19		860.00	0
		Unknown	47		8.13	476.28	113.97
		All	496		85.81	538.06	108.70
	Females	2	0				
		3	30	5.76		650.50	51.11
		4	33	6.33		740.45	63.94
		5	9	1.73		796.67	61.95
		Unknown	10		1.73	758.00	56.97
		All	82		14.19	715.85	77.84
	All fish	2	158		27.34	415.63	27.58
		3	292		50.52	610.99	50.81
		4	61		10.55	711.64	70.39
		5	10		1.73	803.00	61.74
		Unknown	57		9.86	525.71	151.25
		All	578		100.00	563.29	121.83

[a]Number sampled as a percent of the total number of fish sampled with a given fin-mark.

Table 36. Summary of sex and length statistics of marked and unmarked adult chinook salmon sampled at the main fence, 1974.

Mark	Sex	Sample size		Length (mm)	
		Number	% of total	Mean	Standard deviation
Unmarked	Males	153	41.2	458	107
	Females	73	19.7	721	79
	All fish	226	60.9	543	158
Adipose only and adipose and coded-wire tags	Males	136	36.7	605	50
	Females	9	2.4	669	50
	All fish	145	39.1	609	52
Marked and unmarked	Males	289	77.9	527	112
	Females	82	22.1	716	78
	All fish	371	100.0	569	131

Adipose-marked fish were examined for coded-wire tags and it was found that 50 jacks and 123 adults carried readable tags (Table 37).

Distribution counts of the adults released upstream were made from October 14 to November 1, 1975 to determine what areas of the river were utilized for spawning (Table 38). The majority of the fish were found in the area upstream of Hub 200.

EGG DEPOSITION

As indicated above, 21.7% of the adults allowed upstream to spawn were females. Therefore, of the total 176 adults permitted access to the river, 38 were assumed to be females.

None of the females returning in 1974 were sampled for fecundity. Consequently, data from previous years were used to formulate both a regression equation for fecundity and an average egg retention percentage. The estimated total number of eggs deposited in the river above the main fence was determined in turn, on the basis of three assumptions: first, that the mean length of the 38 river-spawning females (716 mm) was the same as that of the 82 females in the hatchery stock (Table 35); second, that the regression equation is applicable; and finally, that the egg retention was the same as in previous years (11.9%).

The average fecundity, egg retention and estimated egg deposition of the 38 females were calculated as follows:

1) Fecundity

Equation: $-1{,}713 + (9.07 \times \text{mean length in mm}) = \text{average number of eggs per female}$

Therefore: $-1{,}713 + (9.07 \times 716) = 4{,}781$ eggs per female

And: $4{,}781 \times 38 = 181{,}678$ eggs produced by 38 females.

Table 37. Coded-wire tag recoveries from adipose-marked adult and jack chinook salmon, 1974.

Jacks			Adults		
Coded-wire tag	Remarks	Number	Coded-wire tag	Remarks	Number
Light green, red	Early release	16	Brown, blue	Hatchery	96
Light green, yellow	Mid release	17	Green, oxide yellow	Wild	27
Light green, blue	Natural food	2	No tag		22
Light green, orange	E.W.O.S.	4	Adipose and left ventral		1
Orange, light green	O.M.P.	6	Adipose and right ventral		1
Purple	Wild	5			
No tag		7			
All marks		57	All marks		147

Table 38. Distribution counts of spawning chinook salmon in the river, 1974.

	River section between hub markers					
Date	101-199	200-257	258-281	282-290	291-297	298-mouth
Oct. 14	234(127)[a]	-	-	-	-	-
20	123	-	-	-	-	-
22	132	5	-	15	15	2
28	63	2	-	-	-	-
Nov. 1	109	-	-	-	-	-

[a]127 adults + 107 jacks = 234

2) Egg Retention

Equation: no. of eggs produced x percent egg retention
= no. of eggs retained

Therefore: 181,678 x 11.9%
= 21,620 eggs retained in the 38 females.

3) Egg Deposition

Equation: no. of eggs produced - no. of eggs retained
= no. of eggs deposited

Therefore: 181,678 - 21,620
= 160,058 eggs deposited by the 38 females.

DOWNSTREAM MIGRATION OF FRY AND SMOLTS

Fry production

A daily enumeration of the chinook fry migrating downstream was conducted at the new fence (Hub 297) from March 1 until May 6, 1975. The catchability coefficient established for chum fry (25) was applied to determine the daily migration. These data indicate that 12,675 chinook fry were produced in the river above the new fence in 1975 (Table 39). Mean daily migration and percent cumulative migration are shown in Fig. 6.

From April 2 until May 2, a total of 219 fry were sampled for length and weight, and an overall condition coefficient of 0.76 was established (Table 40).

Smolt production

Because catchability tests for chinook smolts were not performed for this run, the catchability coefficient of 69 from 1974 data was used to determine the daily migration. The run began May 2, 1975, and by June 18 an estimated 6,897 fish had migrated past the new fence (Table 41). Although natural migration was still in progress, enumeration was curtailed June 19 in anticipation of the release of 230,571 hatchery reared chinook smolts on June 20

Table 39. Daily estimated enumeration of the downstream migration of chinook fry at the new fence, 1975.

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
March 1	300	300	2.4
2	250	550	4.3
3	275	825	6.5
4	200	1,025	8.1
5	175	1,200	9.5
6	200	1,400	11.0
7	225	1,625	12.8
8	150	1,775	14.0
9	50	1,825	14.4
10	175	2,000	15.8
11	250	2,250	17.8
12	275	2,525	19.9
13	300	2,825	22.3
14	350	3,175	25.0
15	425	3,600	28.4
16	400	4,000	31.6
17	425	4,425	34.9
18	500	4,925	38.9
19	350	5,275	41.6
20	200	5,475	43.2
21	125	5,600	44.2
22	75	5,675	44.8
23	50	5,725	45.2
24	75	5,800	45.8
25	125	5,925	46.7
26	75	6,000	47.3
27	25	6,025	47.5
28	75	6,100	48.1
29	50	6,150	48.5
30	125	6,275	49.5
31	75	6,350	50.1
April 1	100	6,450	50.9
2	50	6,500	51.3
3	75	6,575	51.9
4	150	6,725	53.1
5	200	6,925	54.6
6	250	7,175	56.6
7	275	7,450	58.8
8	200	7,650	60.4
9	150	7,800	61.5
10	275	8,075	63.7

(Continued)

Table 39. Daily estimated enumeration of the downstream migration of chinook fry at the new fence, 1975. (Concluded)

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
April 11	275	8,350	65.9
12	275	8,625	68.0
13	600	9,225	72.8
14	275	9,500	75.0
15	175	9,675	76.3
16	400	10,075	79.5
17	225	10,300	81.3
18	350	10,650	84.0
19	275	10,925	86.2
20	300	11,225	88.6
21	325	11,550	91.1
23	250	11,800	93.1
24	300	12,100	95.5
25	150	12,250	96.6
28	350	12,600	99.4
May 6	75	12,675	100.0

[a]Daily migration is the result of multiplying the daily count by the chum fry catchability coefficient of 25.

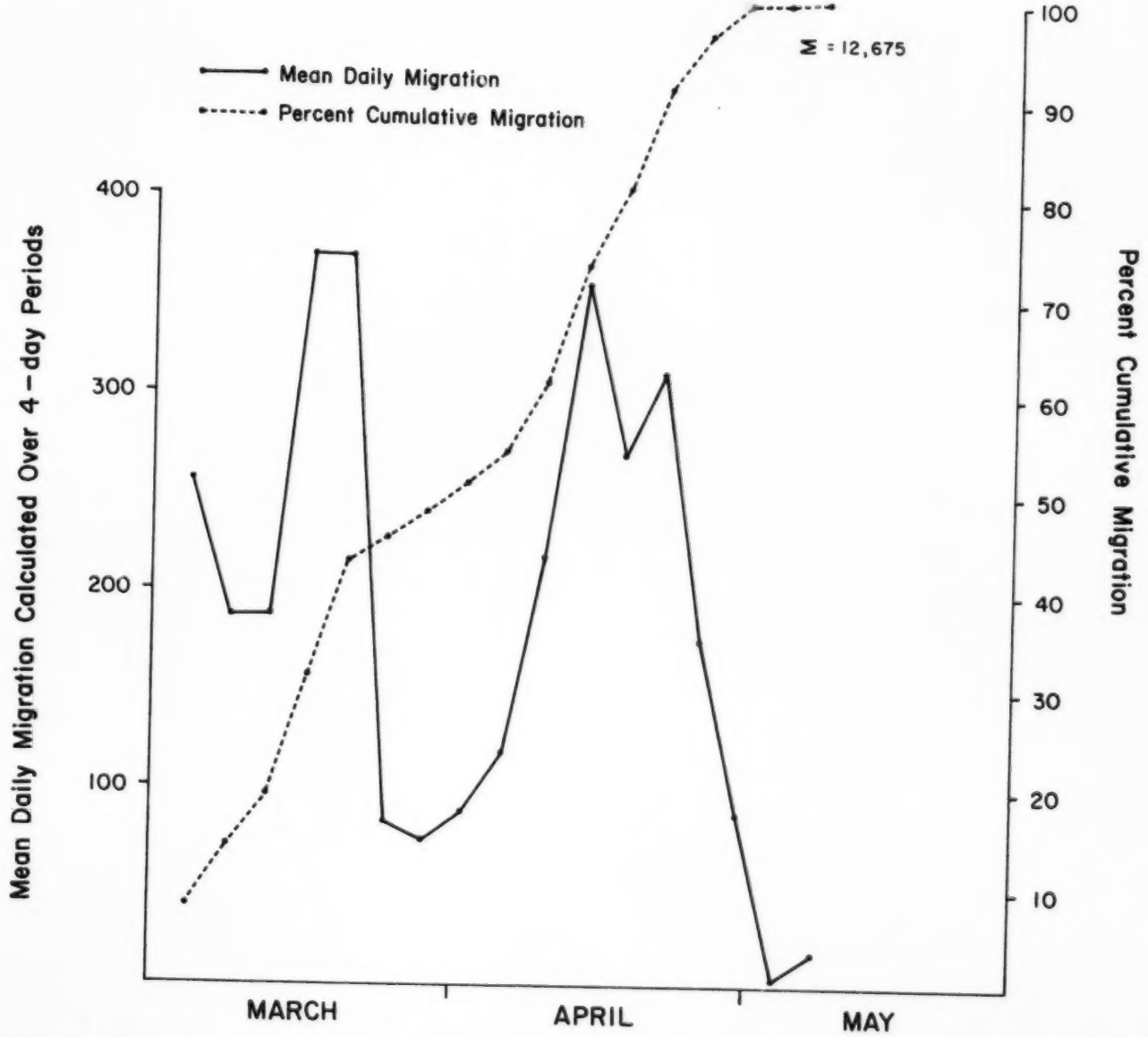

Fig. 6. Downstream migration of chinook fry through the new fence of the Big Qualicum River, 1975.

Table 40. Length, weight and condition coefficient statistics of chinook fry trapped at the new fence, 1975 .

Date	Number sampled	Length (mm)		Weight (g)		Condition coefficient[a]
		Mean	Standard deviation	Mean	Standard deviation	
April 2	3	42.3	1.5	0.52	0.02	0.69
7	11	40.5	2.3	0.48	0.09	0.72
9	6	42.0	1.1	0.55	0.06	0.74
10	11	41.0	2.0	0.51	0.07	0.74
11	12	40.1	1.6	0.49	0.07	0.76
12	11	41.1	1.1	0.50	0.05	0.72
13	24	41.0	2.3	0.51	0.12	0.74
14	11	42.5	2.1	0.58	0.15	0.76
15	7	42.4	2.8	0.62	0.18	0.81
16	15	42.7	1.0	0.57	0.07	0.73
17	9	42.6	0.5	0.57	0.03	0.74
18	12	41.9	1.2	0.57	0.05	0.77
19	13	42.6	1.8	0.59	0.12	0.76
20	19	42.3	1.3	0.57	0.09	0.75
21	12	42.0	1.0	0.54	0.06	0.73
22	4	42.8	2.8	0.59	0.15	0.75
23	10	42.2	0.6	0.58	0.02	0.77
24	6	43.3	3.8	0.65	0.24	0.80
26	4	40.5	2.4	0.52	0.08	0.78
27	4	46.8	4.8	0.88	0.36	0.86
28	4	41.8	0.5	0.52	0.02	0.71
29	7	43.7	4.5	0.66	0.10	0.79
30	3	41.7	0.6	0.56	0.01	0.77
May 2	1	53.0	0	1.36	0	0.91
Overall	219	42.0	2.3	0.56	0.13	0.76

[a] Condition coefficient = weight x 10^5 / $length^3$.

Table 41. Daily estimated enumeration of the downstream migration of chinook smolts at the new fence prior to the release of hatchery-reared smolts,1975.

Date	Daily migration[a]	Cumulative migration
May 2	69	69
4	69	138
7	69	207
13	69	276
15	69	345
16	69	414
17	69	483
22	138	621
25	69	690
26	69	759
28	138	897
29	276	1,173
30	345	1,518
31	138	1,656
June 1	0	1,656
2	207	1,863
3	138	2,001
4	414	2,415
5	69	2,484
6	276	2,760
7	276	3,036
8	483	3,519
9	138	3,657
10	551	4,208
11	138	4,346
12	207	4,553
13	483	5,036
14	276	5,312
15	483	5,795
16	551	6,346
18	551	6,897

[a]Daily migration is the result of multiplying the daily count by the 1974 catchability coefficient of 69 for chinook smolts.

(Table VI). As it was then impossible to distinguish between the wild and hatchery stocks, downstream trapping was terminated. Therefore a total migration figure and percent cumulative migration were not calculated.

From May 6 to June 16, a total of 94 smolts were sampled for length and weight. An average condition coefficient of 1.15 was calculated (Table 42).

Table 42. Length, weight and condition coefficient statistics of chinook smolts trapped at the new fence, 1975.

Date	Number sampled	Length (mm)		Weight (g)		Condition coefficient[a]
		Mean	Standard deviation	Mean	Standard deviation	
May 6	3	46	2	0.84	0.15	0.86
7	5	48	5	1.12	0.40	1.01
8	4	43	1	0.58	0.03	0.73
13	1	57	0	1.67	0	0.90
15	1	57	0	1.85	0	1.00
16	1	56	0	1.67	0	0.95
17	1	65	0	2.98	0	1.09
20	1	64	0	2.65	0	1.01
22	2	69	9	3.62	1.44	1.10
30	5	69	7	3.51	1.15	1.07
31	2	67	4	2.89	0.53	0.96
June 2	3	69	3	3.44	0.41	1.05
3	2	74	8	3.93	1.29	0.97
4	6	71	8	3.87	1.37	1.08
5	1	75	0	4.64	0	1.10
6	4	74	12	4.73	2.32	1.17
7	4	82	1	5.63	0.19	1.02
8	7	79	5	5.26	1.03	1.07
9	2	72	4	3.92	0.80	1.05
10	8	76	8	4.49	1.49	1.02
11	2	73	4	4.18	1.03	1.07
12	3	79	6	4.63	0.61	0.94
13	7	77	11	4.95	1.94	1.08
14	4	75	14	4.74	2.53	1.12
15	7	72	12	4.45	2.09	1.19
16	8	76	9	5.40	2.17	1.23
Overall	94	70	13	3.93	1.95	1.15

[a] Condition coefficient = weight x 10^5 / length^3.

COHO

ENUMERATION AND SAMPLING OF ADULTS AND JACKS

From September 14 until December 24, 1974, coho salmon migrating upstream were enumerated at the main fence (Hub 290). In total, 15,511 adults (Table 43) and 2,827 jacks (Table 44) were counted.

The returning coho were handled in several ways. A total of 6,975 adults and 613 jacks were released upstream through the main fence. They were not sexed or examined for marks. Another 4,395 adults and 978 jacks were trapped, checked for marks but not sexed, and released upstream. Of these, 4,042 adults and all the jacks were unmarked. Twelve jacks were sampled for length prior to their release.

A total of 11,370 adults and 1,591 jacks therefore, were released upstream to spawn. A distribution count was made from November 18 to December 27 to determine spawning locations along the river (Table 45).

The remaining 4,141 adults and 1,236 jacks were trapped and kept in holding ponds at the main fence. Of these 2,237 adults were sold, 1,904 adults were kept for use as hatchery stock, and the jacks, all of which were finmarked, were examined for coded-wire tags.

Holding pond sample

Of the 2,237 fish that were sold, 130 were sampled for weight (Table 46). Of the fish held as brood stock, 205 were sampled for weight (Table 47) and 1,450 for length (Tables 47, 48, 49). In addition, 312 marked jacks were measured to determine a mean length (Table 48).

All marked fish from the holding pond, including those that were sold, were checked for coded-wire tags (Table 50).

A sex-ratio of 61.4% female and 38.6% male was established from a sample of 1,370 marked and unmarked adults. This ratio was thought to be representative of the total migration.

Table 43. Daily enumeration of the upstream migration of adult coho salmon at the main fence, 1974.

Date	Daily count	Cumulative migration	Percent cumulative migration
Sept. 14	1	1	
28	54	55	0.4
29	20	75	0.5
30	16	91	0.6
Oct. 1	4	95	0.6
2	23	118	0.8
3	23	141	0.9
4	15	156	1.0
5	16	172	1.1
6	19	191	1.2
7	19	210	1.4
8[a]	11	237	1.5
9	14	251	1.6
10	35	286	1.8
11	95	381	2.5
12	76	457	2.9
13	51	508	3.3
14	16	524	3.4
15	0	524	3.4
16	47	571	3.7
17	27	598	3.9
18	37	635	4.1
19	44	679	4.4
20	189	868	5.6
21	171	1,039	6.7
22	114	1,153	7.4
23	40	1,193	7.7
24	38	1,231	7.9
25	21	1,252	8.1
26	35	1,287	8.3
27	154	1,441	9.3
28	469	1,910	12.3
29	235	2,145	13.8
30	112	2,257	14.6
31	164	2,421	15.6

(Continued)

Table 43. Daily enumeration of the upstream migration of adult coho salmon at the main fence,1974. (Continued)

Date		Daily count	Cumulative migration	Percent cumulative migration
Nov.	1	114	2,535	16.3
	2	130	2,665	17.2
	3	85	2,750	17.7
	4	375	3,125	20.1
	5	943	4,068	26.2
	6	1,601	5,669	36.5
	7	760	6,429	41.4
	8	596	7,025	45.3
	9	902	7,927	51.1
	10	713	8,640	55.7
	11	155	8,795	56.7
	12	1,262	10,057	64.8
	13	175	10,232	66.0
	14	74	10,306	66.4
	15	39	10,345	66.7
	16	54	10,399	67.0
	17	470	10,869	70.1
	18	655	11,524	74.3
	19	179	11,703	75.4
	20	68	11,771	75.9
	21	59	11,830	76.3
	22	125	11,955	77.1
	23	92	12,047	77.7
	24	806	12,853	82.9
	25	576	13,429	86.6
	26	226	13,655	88.0
	27	100	13,755	88.7
	28	89	13,844	89.3
	29	31	13,875	89.5
	30	67	13,942	89.9
Dec.	1	40	13,982	90.1
	2	59	14,041	90.5
	3	75	14,116	91.0
	4	53	14,169	91.3
	5	53	14,222	91.7
	6	39	14,261	91.9
	7	41	14,302	92.2
	8	37	14,339	92.4
	9	14	14,353	92.5
	10	31	14,384	92.7

(Continued)

Table 43. Daily enumeration of the upstream migration of adult coho salmon at the main fence, 1974. (Concluded)

Date	Daily count	Cumulative migration	Percent cumulative migration
Dec. 11	86	14,470	93.3
12	68	14,538	93.7
13	98	14,636	94.4
14	69	14,705	94.8
15	52	14,757	95.0
16	205	14,962	96.5
17	370	15,332	98.8
18	110	15,442	99.6
19	35	15,477	99.8
20	9	15,486	99.8
21	15	15,501	99.9
22	6	15,507	
23	2	15,509	
24	2	15,511	100.0

[a]Holding pond sort revealed 16 previously uncounted fish which were added to the cumulative total.

Table 44. Daily enumeration of the upstream migration of coho salmon jacks at the main fence, 1974.

Date	Daily count	Cumulative migration	Percent cumulative migration
Oct. 3[a]	22	22	0.8
9[a]	227	249	8.8
15[a]	55	304	10.8
16[a]	407	711	25.2
19[a]	50	761	26.9
21[a]	143	904	32.0
22[a]	63	967	34.2
23[a]	138	1,105	39.1
25[a]	59	1,164	41.2
26[a]	146	1,310	46.3
28[a]	48	1,358	48.0
30[a]	20	1,378	48.7
31	6	1,384	49.0
Nov. 1	13	1,397	49.4
4	16	1,413	50.0
5[b]	54 (39)	1,467	51.9
6	28	1,495	52.9
7	19	1,514	53.6
8	7	1,521	53.8
9	56	1,577	55.8
10	22	1,599	56.6
11	321 (235)	1,920	67.9
12	254 (211)	2,174	76.9
13	96 (88)	2,270	80.3
14	2	2,272	80.4
15	4	2,276	80.5
16	12	2,288	80.9
17	7	2,295	81.2
18	82 (46)	2,377	84.1
19	16	2,393	84.6
20	4	2,397	84.8
21	2	2,399	84.9
22	7	2,406	85.1
23	40	2,446	86.5
24	61	2,507	88.7
25	132 (121)	2,639	93.3
26	5	2,644	93.5
27	7	2,651	93.8
28	4	2,655	93.9
29	2 (1)	2,657	94.0
30	1	2,658	94.0

(Continued)

Table 44. Daily enumeration of the upstream migration of coho salmon jacks at the main fence,1974. (Concluded)

Date	Daily count	Cumulative migration	Percent cumulative migration
Dec. 2	8 (1)	2,666	94.3
3	66 (64)	2,732	96.6
4	6 (3)	2,738	96.9
5	2	2,740	96.9
6	24	2,764	97.8
8	5 (3)	2,769	97.9
9	3	2,772	98.0
10	4 (3)	2,776	98.2
11	19 (15)	2,795	98.9
12	15 (10)	2,810	99.4
13	3	2,813	99.5
14	2	2,815	99.6
15	0	2,815	99.6
16	7 (4)	2,822	99.8
17	3	2,825	99.9
18	0	2,825	
19	0	2,825	
22	1	2,826	
24	1	2,827	100.0

[a]On these dates, counts were derived from holding pond sorts.

[b]Figures in brackets indicate the holding pond count on days when jacks were also counted through the traps; total daily counts are unbracketed on these days.

Table 45. Distribution counts of coho salmon, spawning and holding in the Big Qualicum River, 1974.

Date	Main river section between hub markers					
	101-199	200-257	258-281	282-290	291-297	298-mouth
Nov. 18[a]	792 (643)	(80)	(21)	-	-	-
24	1,339	825	160	310	-	-
Dec. 9	1,008	325	138	330	-	-
15	930	486	178	278	-	-
21	-	-	-	-	60	10
27	-	-	-	-	19	-

[a]Figures in brackets indicate the number of fish actually spawning at the time of the distribution count. Unbracketed figures include counts of fish holding in the spawning areas.

Table 46. Average weight (in kilograms) of coho sampled from those fish sold to Queen Charlotte Fisheries Ltd.,1974.

Mark	Sample size	Total weight	Average weight
Unmarked	100	286	2.9
Adipose clipped	30	89	3.0
Total	130	374	2.9

Table 47. Length and weight statistics of adult coho sampled from the holding pond,1974.

		Length (mm)			Weight (kg)		
Mark	Sex	Sample size	Mean	Standard deviation	Sample size	Mean	Standard deviation
Unmarked	Males	57	488	61	52	2.9	1.2
	Females	122	505	49	58	3.3	1.0
Marked	Males	445	484	50	51	2.7	1.15
	Females	826	497	49	44	3.4	1.15

Table 48. Age, sex and length statistics of marked and unmarked coho adults and jacks sampled at the main fence, 1974.

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample [a]	Mean	Standard deviation
Unmarked	Males	2	12	10.08		312.08	23.30
		3	32	26.89		494.69	59.86
		4	6	5.04		495.00	49.50
		Unknown	19		9.95	475.79	67.17
		All	69		36.13	457.75	87.13
	Females	2	0				
		3	60	50.42		514.53	45.65
		4	9	7.56		513.89	48.40
		Unknown	53		27.75	491.60	50.89
		All	122		63.87	504.52	49.12
	All fish	2	12		6.28	312.08	23.30
		3	92		48.17	507.63	51.60
		4	15		7.85	506.33	48.01
		Unknown	72		37.70	487.43	55.58
		All	191		100.00	487.63	69.27
Adipose only	Males	2	26	76.47		287.31	13.87
		3	3	8.82		526.67	66.58
		4	0				
		Unknown	35		17.41	488.00	57.33
		All	64		31.84	408.28	110.58

(Continued)

Table 48. Age, sex and length statistics of marked and unmarked coho adults and jacks sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample [a]	Mean	Standard deviation
Adipose only	Females	2	0				
		3	4	11.76		477.50	13.23
		4	1	2.94		565.00	0
		Unknown	132		65.67	488.67	48.23
		All	137		68.16	488.91	47.86
	All fish	2	26		12.94	287.31	13.87
		3	7		3.48	498.57	47.50
		4	1		0.50	565.00	0
		Unknown	167		83.08	488.63	50.09
		All	201		100.00	463.23	82.63
Adipose and coded-wire tag							
Lt. blue, blue ('71 Brood)	Males	3	107	38.49		499.30	49.66
	Females	3	171	61.51		512.75	47.10
	All fish	3	278		100.00	507.57	48.46

(Continued)

Table 48. Age, sex and length statistics of marked and unmarked coho adults and jacks sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose and coded-wire tags							
White ('71 Brood)	Males	3	104	36.88		485.19	46.57
	Females	3	178	63.12		509.35	48.44
	All fish	3	282		100.00	500.44	49.08
White, blue ('71 Brood)	Males	3	134	36.22		469.25	44.46
	Females	3	236	63.78		483.81	45.81
	All fish	3	370		100.00	478.54	45.80
Lt. blue, purple ('71 Brood)	Males	3	53	37.59		488.58	48.37
	Females	3	88	62.41		491.65	47.08
	All fish	3	141		100.00	490.50	47.42
Lt. blue, pink ('71 Brood)	Males	3	9	36.00		453.90	60.60
	Females	3	16	64.00		483.40	57.10
	All fish	3	25		100.00	472.80	58.90

(Continued)

Table 48. Age, sex and length statistics of marked and unmarked coho adults and jacks sampled at the main fence, 1974. (Continued)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Adipose and coded-wire tags							
10/2/1 ('72 Brood)	Males	2	90	100.0	100.0	289.4	19.8
1/2/2 ('72 Brood)	Males	2	127	100.0	100.0	284.0	17.8
4/2/2 ('72 Brood)	Males	2	55	100.0	100.0	280.0	13.6
2/2/2 ('72 Brood)	Males	2	14	100.0	100.0	271.4	16.3
Marked and unmarked	Males	2	324	21.1		285.6	18.8
		3	442	28.8		484.5	49.7
		4	6	0.4		495.0	49.5
		Unknown	54		3.0	483.7	60.6
		All	826		46.6	406.5	105.7

(Continued)

Table 48. Age, sex and length statistics of marked and unmarked coho adults and jacks sampled at the main fence, 1974. (Concluded)

Mark	Sex	Age (years)	Sample size			Length (mm)	
			Number	% of aged, sexed fish	% of sample[a]	Mean	Standard deviation
Marked and unmarked	Females	2	0				
		3	753	49.1		499.7	48.7
		4	10	0.7		519.0	48.4
		Unknown	185		10.4	489.5	48.9
		All	948		53.4	498.0	48.9
	All fish	2	324		18.3	285.6	18.8
		3	1,195		67.4	494.1	49.6
		4	16		0.9	510.0	48.7
		Unknown	239		13.5	488.2	51.7
		All	1,774		100.0	455.4	92.5

[a]Number sampled as a percent of the total number of fish sampled with a given mark.

Table 49. Summary of sex and length statistics of marked and unmarked adult coho salmon sampled at the main fence,1974.

Mark	Sex	Sample size		Length (mm)	
		Number	% of total	Mean	Standard deviation
Unmarked	Males	57	3.9	488.4	61.1
	Females	122	8.4	504.5	49.1
	All fish	179	12.3	499.4	53.6
Adipose only, and adipose and coded-wire tags	Males	445	30.7	484.1	49.5
	Females	826	57.0	497.0	48.8
	All fish	1,271	87.7	492.5	49.4
Marked and unmarked	Males	502	34.6	484.6	50.9
	Females	948	65.4	498.0	48.9
	All fish	1,450	100.0	493.3	50.0

Table 50. Mark recoveries from adult coho salmon of the 1971 brood in the Big Qualicum River system,1974.

Sample area	Adipose only	Coded-wire tags (Release group)					Total marked
		White (Mid release)	White, blue (Late release)	Lt. blue, blue (Early release)	Lt. blue, purple (O.M.P. + natural food)	Lt. blue, pink (Wild)	
Holding pond	115	300	387	304	157	27	1,290
Main river dead	73	168	239	156	86	14	736
Spawning channel dead	51	92	147	122	58	7	477
Fish sale	65	259	402	285	129	37	1,177
All samples	304	819	1,175	867	430	85	3,680
% of all recoveries	8	22	32	24	12	2	100

Spawning channel sample

During the stocking of the spawning channel with chum salmon, some coho inadvertently gained access. The majority schooled up at the lower end of the channel and were seined back into the main river. Those that were missed, were subsequently dead-pitched from the channel (Table 51), and all marked fish were sampled for tags (Tables 50,52).

Main fence sample

A total of 337 adults were dead-pitched from the river above the main fence (Table 53) and marked fish were examined for tags (Tables 50, 52). Using the sample data, a marked-to-unmarked ratio was calculated for each group. Marked fish comprised 54.1% of the total sample (Table 54).

EGG DEPOSITION

The sex-ratio established above, indicates that 61.4% or 6,981 of the 11,370 adults released upstream to spawn were females. A mean egg retention of 18.5% was observed in a sample of 63 spent females taken from the river. The egg deposition in the river above the main fence was calculated in turn, on the basis of three assumptions: first, that the mean length of the river spawning females was the same (498 mm) as that of the 948 females sampled from the hatchery stock (Table 49); second, that the regression equation for fecundity versus length, based on data from 1959 to 1973, is applicable; and third, that the mean egg retention referred to above is also representative.

Fecundity, egg retention and egg deposition therefore, were calculated as follows:

Table 51. Fin-mark incidence of spent coho salmon dead-pitched from the spawning channel, 1974-1975.

Date	All fish		Adipose-marked fish	
	Daily count	Cumulative count	Daily count	Cumulative count
Nov. 27	16	16	6	6
(1974) 28	25	41	7	13
29	13	54	6	19
30	18	72	5	24
Dec. 1	24	96	10	34
2	42	138	23	57
3	55	193	18	75
4	59	252	32	107
5	65	317	44	151
6	58	375	29	180
7	46	421	25	205
8	49	470	27	232
9	42	512	21	253
10	25	537	13	266
11	22	559	12	278
12	86	645	50	328
13	--	645	--	328
14	34	679	20	348
15	20	699	13	361
16	29	728	17	378
17	6	734	3	381
18	39	773	11	392
19	3	776	2	394
20	--	776	--	394
21	12	788	9	403
22	4	792	1	404
23	18	810	11	415
24	2	812	--	415
25	--	812	--	415
27	12	824	11	426
28	6	830	2	428
29	3	833	--	428
30	11	844	9	437
31	5	849	4	441

(Continued)

Table 51. Fin-mark incidence of spent coho salmon dead-pitched from the spawning channel, 1974-1975. (Concluded)

Date	All fish		Adipose-marked fish	
	Daily count	Cumulative count	Daily count	Cumulative count
Jan. 2	11	860	6	447
(1975) 3	6	866	5	452
4	8	874	6	458
5	3	877	3	461
6	5	882	5	466
7	4	886	3	469
8	1	887	1	470
9	2	889	1	471
13	10	899	6	477

Table 52. Mark recoveries from adipose-marked jack coho salmon in the Big Qualicum River system, 1974.

Sample area	Coded-wire tags						No tag	Tags unreadable	Total no. marked
	1/2/2	10/2/1	2/2/2	4/2/2	4/2/1	Chrome yellow			
Main river and holding pond	473	287	159	170	1	1	141	4	1,236
Spawning channel	-	-	2	1	-	-	-	-	3
Fish sale	-	2	3	-	-	-	-	-	5
All samples	473	289	164	171	1	1	141	4	1,244
% of total recovery	38	23	13	13	-	-	11	-	99

Table 53. Fin-mark incidence of adult coho salmon dead-pitched above the main fence, 1974-1975.

Date	All fish		Adipose-marked fish	
	Daily count	Cumulative count	Daily count	Cumulative count
Oct. 31 (1974)	4	4	2	2
Nov. 1	3	7	-	2
2	3	10	-	2
3	4	14	1	3
4	1	15	1	4
5	1	16	-	4
8	1	17	-	4
12	1	18	1	5
14	1	19	-	5
23	3	22	2	7
24	1	23	-	7
30	4	27	1	8
Dec. 1	2	29	2	10
5	21	50	14	24
6	9	59	3	27
7	12	71	5	32
8	5	76	3	35
9	10	86	6	41
10	17	103	6	47
12	12	115	12	59
13	8	123	3	62
15	3	126	3	65
16	19	145	9	74
17	10	155	7	81
18	12	167	5	86
19	6	173	3	89
20	6	179	4	93
21	23	202	13	106
22	29	231	21	127
23	24	255	13	140
24	15	270	6	146
27	22	292	10	156
28	4	296	3	159
29	2	298	1	160
30	10	308	8	168
31	5	313	4	172

(Continued)

Table 53. Fin-mark incidence of adult coho salmon dead-pitched above the main fence, 1974-1975. (Concluded)

Date	All fish		Adipose-marked fish	
	Daily count	Cumulative count	Daily count	Cumulative count
Jan. 4	4	317	3	175
(1975) 5	7	324	2	177
6	8	332	3	180
7	5	337	3	183

Table 54. Ratio of marked-to-unmarked coho salmon sampled at various locations along the river, 1974.

Sample location	Number marked	Number unmarked	Total	% marked
Main fence	183	154	337	54.3
Spawning channel	477	422	899	53.1
Fish sale	1,177	1,060	2,237	52.6
Holding pond and released to the river	1,633	1,312	2,945	55.4
All locations	3,470	2,948	6,418	54.1

1) Fecundity

Equation: -1,885 + (8.47 x mean length in mm)
= average number of eggs per female

Therefore: -1,885 + (8.47 x 498)
= 2,333 eggs per female

And: 2,333 x 6,981
= 16,286,673 eggs produced by 6,981 females

2) Egg Retention

Equation: no. of eggs produced x percent egg retention
= no. of eggs retained

Therefore: 16,286,673 x 18.5%
= 3,013,035 eggs retained by 6,981 females

3) Egg Deposition

Equation: no. of eggs produced - no. of eggs retained
= no. of eggs deposited

Therefore: 16,286,673 - 3,013,035
= 13,273,638 eggs deposited by 6,981 females

DOWNSTREAM MIGRATION OF FRY AND SMOLTS

Fry production

Coho fry were enumerated at the new fence from March 2 until June 19, 1975. The estimated daily migration was determined by using the catchability coefficient of 25 established for chum fry (Table 55). In total 1,652,875 coho fry migrated downstream in the spring of 1975 (Fig. 7). This includes 42,115 hatchery-produced fry that were released April 8.

Smolt production

Catchability tests for coho smolts were not conducted in 1975. Therefore, the catchability coefficient of 86 calculated from 1974 data was used to determine the daily migration. From March 3 to May 22, 1975, a total of 9,374 coho smolts had migrated through the new fence (Table 56).

Table 55. Daily estimated enumeration of the downstream migration of coho fry at the new fence,1975.

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
March 2	25	25	
5	25	50	
6	25	75	
8	50	125	
9	75	200	
10	100	300	
11	100	400	
12	75	475	
13	75	550	
14	150	700	
15	175	875	0.1
16	75	950	0.1
17	100	1,050	0.1
18	75	1,125	0.1
19	50	1,175	0.1
21	50	1,225	0.1
22	25	1,250	0.1
23	25	1,275	0.1
24	25	1,300	0.1
26	50	1,350	0.1
29	25	1,375	0.1
30	50	1,425	0.1
31	25	1,450	0.1
April 1	100	1,550	0.1
2	50	1,600	0.1
3	75	1,675	0.1
4	150	1,825	0.1
5	250	2,075	0.1
6	300	2,375	0.1
7	400	2,775	0.1
8	475	3,250	0.2
9	22,700	25,950	0.2
10	3,600	29,550	1.6
11	1,925	31,475	1.8
12	1,050	32,525	1.9
13	825	33,350	2.0
14	1,225	34,575	2.0
15	1,075	35,650	2.1
16	1,425	37,075	2.2
17	1,625	38,700	2.2
18	2,125	40,825	2.3
19	2,375	43,200	2.5
20	3,625	46,825	2.6

(Continued)

Table 55. Daily estimated enumeration of the downstream migration of coho fry at the new fence, 1975. (Continued)

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
April 21	1,175	48,000	2.9
22	4,625	52,625	3.2
23	775	53,400	3.2
24	475	53,875	3.3
25	150	54,025	3.3
26	1,975	56,000	3.4
27	9,200	65,200	3.9
28	10,275	75,475	4.6
29	43,600	119,075	7.2
30	40,075	159,150	9.6
May 1	32,700	191,850	11.6
2	44,550	236,400	14.3
3	45,475	281,875	17.1
4	29,300	311,175	18.8
5	48,700	359,875	21.8
6	28,900	388,775	23.5
7	30,125	418,900	25.3
8	65,225	484,125	29.3
9	44,950	529,075	32.0
10	243,750	772,825	46.8
11	99,000	871,825	52.7
12	41,150	912,975	55.2
13	96,550	1,009,525	61.1
14	55,600	1,065,125	64.4
15	71,050	1,136,175	68.7
16	41,200	1,177,375	71.2
17	22,900	1,200,275	72.6
18	19,325	1,219,600	73.8
19	5,675	1,225,275	74.1
20	6,850	1,232,125	74.5
21	18,700	1,250,825	75.7
22	17,775	1,268,600	76.8
23	9,125	1,277,725	77.3
24	26,600	1,304,325	78.9
25	44,025	1,348,350	81.6
26	8,100	1,356,450	82.1
27	8,950	1,365,400	82.6
28	10,700	1,376,100	83.3
29	11,725	1,387,825	84.0
30	57,000	1,444,825	87.4
31	47,000	1,491,825	90.3

(Continued)

Table 55. Daily estimated enumeration of the downstream migration of coho fry at the new fence, 1975. (Concluded)

Date		Daily migration[a]	Cumulative migration	Percent cumulative migration
June	1	32,475	1,524,300	92.2
	2	20,300	1,544,600	93.4
	3	16,900	1,561,500	94.5
	4	27,700	1,589,200	96.1
	5	6,850	1,596,050	96.6
	6	2,025	1,598,075	96.7
	7	2,050	1,600,125	96.8
	8	4,700	1,604,825	97.1
	9	6,600	1,611,425	97.5
	10	5,625	1,617,050	97.8
	11	8,375	1,625,425	98.3
	12	4,875	1,630,300	98.6
	13	6,225	1,636,525	99.0
	14	5,600	1,642,125	99.3
	15	4,025	1,646,150	99.6
	16	3,525	1,649,675	99.8
	17	1,000	1,650,675	99.9
	18	1,575	1,652,250	
	19	625	1,652,875	100.0

[a]Daily migration is the result of multiplying the daily count by the catchability coefficient of 25 for chum fry.

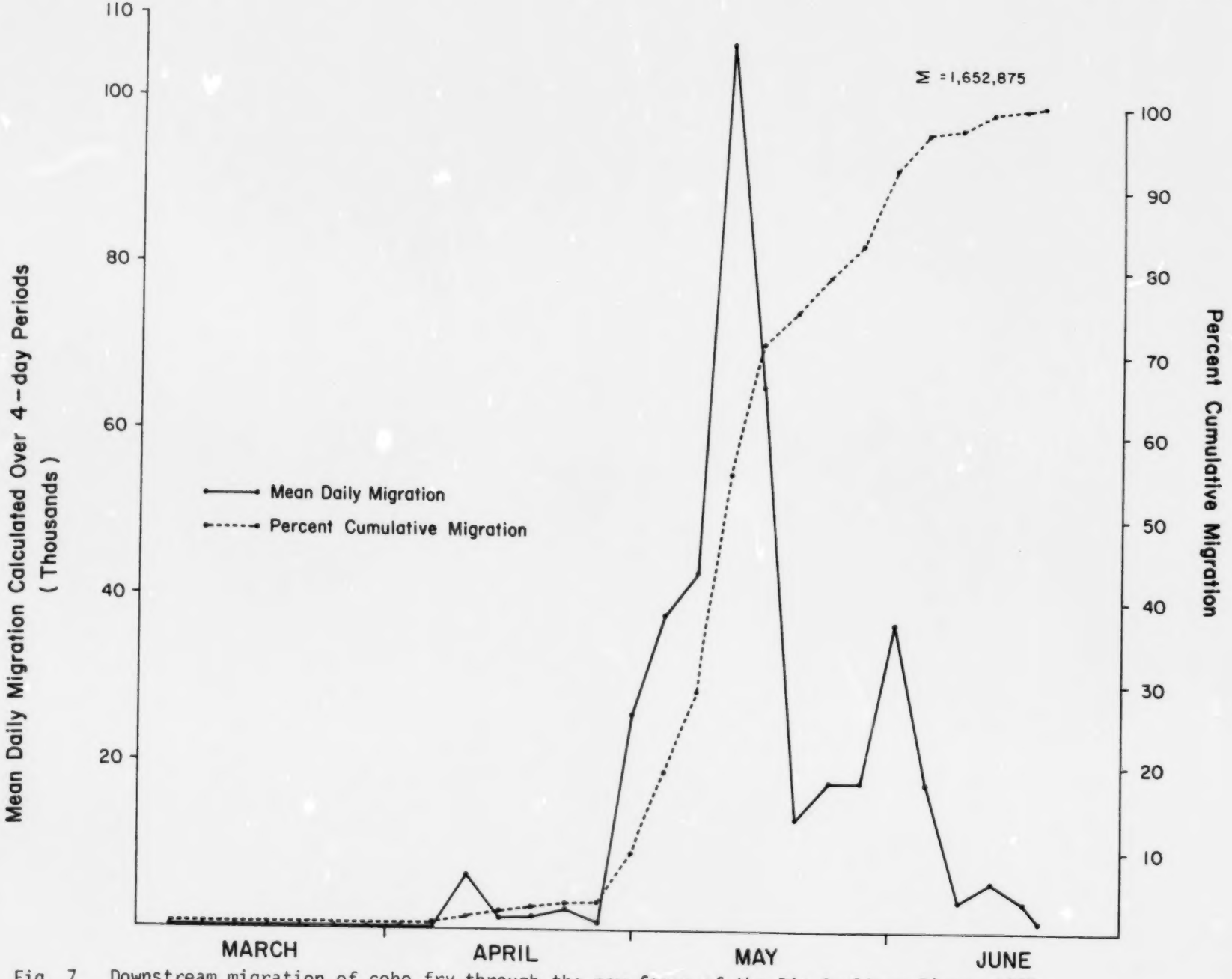

Fig. 7. Downstream migration of coho fry through the new fence of the Big Qualicum River, 1975.

Table 56. Daily estimated enumeration of the downstream migration of coho smolts at the new fence prior to the release of hatchery-reared smolts,1975.

Date	Daily migration[a]	Cumulative migration
March 3	86	86
6	86	172
11	86	258
15	86	344
18	86	430
20	86	516
27	86	602
April 5	86	688
13	86	774
14	86	860
15	86	946
17	86	1,032
29	86	1,118
May 1	86	1,204
2	86	1,290
10	86	1,376
11	172	1,548
12	172	1,720
13	430	2,150
14	1,032	3,182
15	774	3,956
16	688	4,644
17	774	5,418
18	1,032	6,450
19	946	7,396
20	774	8,170
21	516	8,686
22	688	9,374

[a]Daily migration is the result of multiplying the daily count by the 1974 catchability coefficient of 86 for coho smolts.

On May 23, a total of 377,765 hatchery-produced smolts were released from the rearing channel to migrate downstream (Table VI). Upon reaching the new fence however, the fish massed and passed through only in small numbers. As a result, they were exposed to heavy predation by birds. In turn, the coho consumed large numbers of chum fry. To alleviate the situation, the fence was opened wide on May 23rd and 24th. This allowed most of the reared fish access downstream. Trapping was resumed May 25. As it was impossible to distinguish between the natural and hatchery fish, enumeration was terminated. Between April 13 and May 22, a total of 92 coho were sampled for length and weight. An overall condition coefficient of 1.17 was calculated (Table 57).

Table 57. Length, weight and condition coefficient statistics of coho smolts trapped at the new fence, 1975.

Date	Number sampled	Length (mm)		Weight (g)		Condition coefficient[a]
		Mean	Standard deviation	Mean	Standard deviation	
April 13	1	89.0	0	8.73	0	1.24
14	1	70.0	0	3.87	0	1.13
15	1	80.0	0	5.69	0	1.11
17	1	89.0	0	7.54	0	1.07
29	1	92.0	0	8.97	0	1.15
May 2	1	86.0	0	7.25	0	1.14
11	2	98.5	6.4	11.68	3.35	1.22
12	2	105.5	0.7	13.55	0.27	1.15
13	5	96.6	8.4	10.36	3.25	1.15
14	12	94.1	10.2	9.51	3.29	1.14
15	9	100.0	12.6	11.67	4.54	1.17
16	7	109.4	6.7	15.49	2.88	1.18
17	9	109.9	13.8	15.39	5.38	1.16
18	10	100.0	11.0	11.64	4.45	1.16
19	10	103.1	14.7	12.60	5.20	1.15
20	9	105.9	9.7	12.15	4.06	1.02
21	3	112.7	11.9	16.73	5.15	1.17
22	8	103.6	8.4	13.83	3.78	1.24
Overall	92	101.4	12.3	12.21	4.54	1.17

[a] Condition coefficient = weight x 10^5 / length^3.

STEELHEAD

UPSTREAM MIGRATION OF ADULTS

The first adult steelhead was trapped at the main fence on October 9, 1974. When enumeration was terminated on December 24, a total of 39 fish had been counted (Table 58). The steelhead migration continued through the winter and into April, 1975. The total migration was not known however, and the percent migration therefore, could not be calculated.

On April 2nd, 41 steelhead were seined from the river. Of these, 8 unmarked males and 19 unmarked females were held for brood stock. The remaining 14 marked fish, comprised of 10 males and 4 females were released.

DOWNSTREAM MIGRATION OF JUVENILES

Hatchery-reared smolts

On May 16, 1975, a total of 9,761 marked steelhead smolts were released (Table VI). Undersized, these fish were introduced in the upper river in an attempt to lengthen their time in the river and thereby increase growth prior to entering the Strait. However, most of the smolts migrated past the new fence by May 20 (Table 59). A catchability coefficient was calculated as follows:

number marks released / number marks recaptured

= 9,761 / 77

= 127

Because these fish were small and perhaps more readily caught, this coefficient was considered to represent minimum catchability.

On May 23, an additional 23,085 marked smolts were released in the lower river (Table VI). Although these fish were larger and likely more typical of the natural migrants, a catchability coefficient could not be calculated as

Table 58. Daily enumeration of the upstream migration of adult steelhead trout at the main fence,1974.

Date	Daily count	Cumulative migration
Oct. 9	1	1
10	1	2
11	1	3
Nov. 26	1	4
Dec. 1	1	5
2	1	6
4	1	7
8	1	8
9	1	9
10	5	14
13	2	16
14	2	18
16	4	22
17	4	26
18	4	30
19	4	34
20	3	37
21	1	38
24	1	39

Table 59. Daily enumeration of the downstream migration of hatchery-reared marked steelhead smolts at the new fence,1975.

Date	Daily catch	Cumulative catch
May 16	1	1
17	59	60
18	9	69
19	7	76
20[a]	1	77
25	28	105
26	9	114
27	7	121
28	9	130
29	1	131
30	1	132
31	1	133
June 1	2	135
2	1	136
3	3	139
4	4	143
5	3	146
6	2	148
7	2	150
9	1	151
10	1	152
12	1	153
14	1	154
15[b]	1	155

[a]May 16 to May 20 catch data for 9,761 smolts released May 16 in upper river.

[b]May 25 to June 15 catch data for 23,085 smolts released May 23 in lower river. (Only partially complete as marked fish were still migrating past the fence after enumeration ceased).

marked fish were still going through the fence after enumeration activities had ceased.

Natural smolt production

Enumeration of wild steelhead smolts began March 5 and was terminated June 18, 1975. Because all reared smolts were marked, their release did not interfere with estimating the natural production. The catchability coefficient calculated above was applied to the daily catch. An estimated 9,525 steelhead smolts migrated downstream (Table 60). Length and weight data were collected from 53 fish and a condition coefficient of 1.16 was calculated (Table 61).

Fry production

The steelhead fry migration began June 3, 1975. Application of the catchability coefficient for chum fry to the daily catch resulted in a total migration of 5,175 by June 19 (Table 62).

Table 60. Daily estimated enumeration of the downstream migration of wild steelhead smolts at the new fence, 1975.

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
March 5	127	127	1.3
20	127	254	2.7
27	127	381	4.0
April 17	127	508	5.3
20	127	635	6.7
22	127	762	8.0
27	127	889	9.3
29	127	1,016	10.7
May 6	254	1,270	13.3
12	254	1,524	16.0
13	381	1,905	20.0
14	254	2,159	22.7
15	381	2,540	26.7
16	508	3,048	32.0
17	254	3,302	34.7
18	127	3,429	36.0
19	254	3,683	38.7
20	508	4,191	44.0
22	508	4,699	49.3
23[b]	254	4,953	52.0
24[b]	254	5,207	54.7
25	254	5,461	57.3
26	254	5,715	60.0
27	127	5,842	61.3
28	381	6,223	65.3
29	254	6,477	68.0
30	635	7,112	74.7
June 1	127	7,239	76.0
2	127	7,366	77.3
3	127	7,493	78.7
4	254	7,747	81.3

(Continued)

Table 60. Daily estimated enumeration of the downstream migration of wild steelhead smolts at the new fence, 1975. (Concluded)

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
June 7	254	8,001	84.0
8	254	8,255	86.7
9	381	8,636	90.7
10	381	9,017	94.7
11	127	9,144	96.0
12	127	9,271	97.3
17	127	9,398	98.7
18	127	9,525	100.0

[a]Daily migration is the result of multiplying the daily count by the catchability coefficient of 127 for steelhead smolts.

[b]Average estimates only as the fence was kept open to permit escape of reared coho smolts.

Table 61. Length, weight and condition coefficient statistics of steelhead smolts trapped at the new fence, 1975.

Date	Number sampled	Length (mm)		Weight (g)		Condition coefficient[a]
		Mean	Standard deviation	Mean	Standard deviation	
April 17	1	91	0	7.47	0	0.99
20	1	87	0	6.94	0	1.05
22	1	125	0	19.41	0	0.99
27	1	163	0	33.91	0	0.78
29	1	132	0	23.67	0	1.03
May 6	2	154	45	47.45	37.67	1.30
12	2	165	57	58.68	51.15	1.31
13	3	183	8	66.13	3.44	1.08
14	2	191	13	75.84	5.85	1.09
15	3	158	40	49.23	31.48	1.25
16	4	180	35	63.20	29.13	1.08
17	2	154	23	38.61	12.86	1.06
18	1	194	0	68.85	0	0.94
19	1	166	0	52.01	0	1.14
20	4	166	15	45.66	10.70	1.00
22	4	157	30	51.66	23.46	1.34
25	2	172	21	54.81	14.02	1.08
30	4	154	26	43.01	17.05	1.18
31	1	214	0	102.95	0	1.05
June 1	1	158	0	43.32	0	1.10
3	1	155	0	34.46	0	0.93
6	2	138	18	30.66	15.00	1.17
7	1	111	0	16.32	0	1.19
8	2	165	14	46.73	6.36	1.04
9	3	152	28	37.19	17.47	1.06
10	3	159	17	41.48	16.28	1.03
Overall	53	160	30	47.38	23.24	1.16

[a] Condition coefficient = weight x 10^5 / length^3.

Table 62. Daily estimated enumeration of the downstream migration of steelhead fry at the new fence, 1975.

Date	Daily migration[a]	Cumulative migration	Percent cumulative migration
June 3	1,100	1,100	21.3
4	425	1,525	29.5
5	550	2,075	40.1
7	100	2,175	42.0
9	50	2,225	43.0
10	200	2,425	46.9
13	850	3,275	63.3
14	250	3,525	68.1
15	200	3,725	72.0
16	425	4,150	80.2
18	850	5,000	96.6
19	175	5,175	100.0

[a]Daily migration is the result of multiplying the daily count by the chum catchability coefficient of 25.

Table I. Summary of chum fry migrations (in millions) for the brood years 1967 to 1975

Brood year	Mark	Origin	Number of fry			Percent marked
			Marked	Unmarked	Total	
1967	AD/LV	Channel	0.38	11.2	11.6	3.3
	AD/RV	River	0.40	21.2	21.6	1.9
		System	0.78	32.4	33.2	2.3
1968	AD/RV	Channel	0.43	14.8	15.2	2.8
	AD/LV	River	2.14	31.6	33.8	6.3
	AD/AN	Reared	0.11	2.0	2.1	5.2
		System	2.68	48.4	51.1	5.2
1969	AD/RV	Channel	0.68	18.8	19.5	3.5
	AD/LV	River	1.22	40.6	41.9	2.9
	AD/AN	Reared	0.07	1.5	1.6	4.4
		System	1.97	60.9	63.0	3.1
1970	AD/RV	Channel	0.66	19.8	20.5	3.2
	AD/LV	River	0.90	26.9	27.7	3.2
		System	1.56	46.7	48.2	3.2
1971	AD/RV	Channel	0.97	18.1	19.1	5.1
	None	River	0	17.5	17.5	0
		System	0.97	35.6	36.6	2.7
1972	AD/RV	Channel	0.98	21.5	22.5	4.4
	None	River	0	22.7	22.7	0
		System	0.98	44.2	45.2	2.2
1973	AD/RV	Channel	1.0	20.7	21.7	4.6
	None	River	0	22.7	22.7	0
		System	1.0	43.4	44.4	2.3
1974	AD/RV	System	0.1	52.2	52.3	0.2
1975	AD/RV	System	0.1	64.9	65.0	0.2

Table II. Fin-mark incidence in the chum salmon survey of the commercial processing plant, 1974.

Fishery date	Catch Area	Catch	Sample	Mark	Mark recovery at age 3	4	5
Sept. 29-	12	61,418	0				
Oct. 1	13	40,151	0				
Oct. 20-	12	42,630	6,982	AD/LV	0	4	2
Oct. 22				AD/RV	2	3	1
				AD/AN	0	0	0
	13	71,266	13,864	AD/LV	0	10	2
				AD/RV	6	6	3
				AD/AN	0	0	1
Oct. 30-	14	10,310	0				
Oct. 31	17	15,812	0				

Table III. Migration time (in number of days) of Big Qualicum chum salmon from the Catch Area to the main fence of the Big Qualicum River.

Week ending:	From Area 12 (Upper Johnstone Strait)	From Area 13 (Lower Johnstone Strait)	From Area 14 (Qualicum-Baynes Sound)
Oct. 7	41.4	32.3	--
14	40.9	31.8	--
21	40.8	31.7	24.2
28	33.0	23.9	21.8
Nov. 4	34.4	25.3	21.7
11	33.7	24.6	16.8
18	30.2	21.1	10.1
25	--	--	8.9
Dec. 2	--	--	8.2
Seasonal	35.7	26.6	9.8
Standard error	0.45	0.53	0.21

Table IV. Age and origin of Big Qualicum chum salmon in the escapements from 1972 to 1974.

Return year	Age (years)	Brood year	Origin				
			River	Spawning channel	Freshwater reared	Unassigned	All Sources
1972	3	1969	8,065	1,200	-	-	9,265
	4	1968	44,241	18,419	3,475	-	66,135
	5	1967	2,277	2,836	-	-	5,113
	All		54,583	22,455	3,475	-	80,513
1973	3	1970	365	-	-	-	365
	4	1969	92,760	32,673	1,566	-	126,999
	5	1968	25,855	9,975	446	-	36,276
	6	1967	-	-	-	316	316
	All		118,980	42,648	2,012	316	163,956
1974	3	1971	-	161	-	21,581	21,742
	4	1970	19,083	7,318	-	-	26,401
	5	1969	24,727	19,864	2,236	-	46,827
	6	1968	1,426	-	-	-	1,426
	All		45,236	27,343	2,236	21,581	96,396

Table V. Age and origin of Big Qualicum chum salmon in the commercial fisheries from 1972 to 1974.

Return year	Age (years)	Brood year	Origin				
			River	Spawning channel	Freshwater reared	Unassigned	All Sources
1972	3	1969	5,478	5,490	-	-	10,968
	4	1968	86,733	54,894	5,943	-	147,570
	5	1967	4,021	1,627	-	-	5,648
	All		96,232	62,011	5,943	-	164,186
1973	3	1970	939	-	-	-	939
	4	1969	148,068	77,561	11,126	-	236,750
	5	1968	31,081	18,964	787	-	50,832
	All		180,083	96,525	11,913	-	288,521
1974	3	1971	-	43	-	1,640	1,683
	4	1970	2,467	1,626	-	-	4,093
	5	1969	833	664	141	-	1,683
	All		3,300	2,333	141	1,640	7,414

Table VI. Release summary of hatchery-reared juveniles, 1975.

	Chinook	Coho	Steelhead	
Brood year	1974	1973	1973	
Release date (1975)	June 20	May 23	May 16	May 23
Release group	-	-	Upper river	Lower river
Coded-wire tag[a]	10/2/2	9/2/2	Green, blue	Red
Total number released	230,571	377,765	9,761	23,085
Number of marked fish released	100,390	59,999	9,761	23,085
Adjusted number of marked fish released[b]	-	57,425	7,418	22,623
Size of fish released (no. / lb.)	55.4	17.9	22.0	8.0

[a]Tagged fish were also marked with an adipose clip.

[b]Adjusted to account for tag loss.